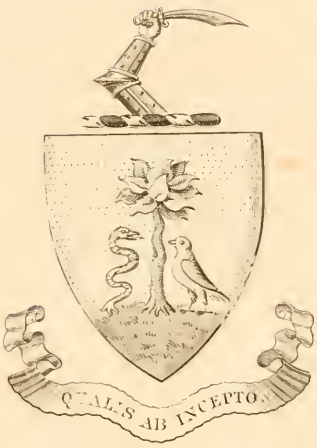
BRITISH DRAGON FLIES · Odonata

BY W. J. LUCAS · BA · FES



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BRITISH DRAGONFLIES.

British Dragonflies

(Odonata).

By

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(Author of "British Hawk Moths," "British Butterflies," &c.).

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PREFACE.

LITTLE by way of Preface should be required in the case of a book for which there exists an admitted demand. That the Dragonflies have been neglected may be—no doubt is—due to the fact that the information about them has hitherto been so widely scattered in the magazines and general entomological literature as to be far from readily accessible. Consequently, the first attempt to collect the scattered facts, and to make such additions as were possible, will necessarily leave much to be done in the future, more especially as regards the earlier stages of the insects.

An interesting phase of the subject beyond the mere classification and other bookwork, is that which deals with the habits of the insects in their native haunts, and this in the past has been scarcely touched upon. I am only too mindful of the fact that in the present work the account of the distribution of the various species is often very scanty. This arises from two causes, the paucity of field-workers and the apparent dislike of many to record their captures, more particularly in the case of the commoner insects.

As many as possible of the full-grown nymphs have been described, and one at least of each sub-family has been figured. There are still, however, several species almost or quite unknown in the earlier stages. For the description of six nymphs, and figures of two, I am indebted to Mr. L. Cabot's papers on the "Immature State of the Odonata," contained in the Memoirs of the Museum of Comparative Zoology, at Harvard College, U.S.A., and for them I desire to express my obligation.

So far as the Synonymy is concerned, reference has been made to all such authors as are likely to be consulted by ordinary readers, and, in addition, to such others as were found responsible for any of the Synonyms. In connection with the descriptions it may be well to state that those points which are similar in both sexes have been omitted in the case of the female. In all Dragonflies a knowledge of the immature, or teneral, condition is important, but, unfortunately, details concerning it are not often obtainable or, in many instances, easily observed. In this we have another important branch of the subject which requires more extended investigation. The reputed species have designedly been relegated very much to the back-ground, their claims to being considered British being so slender. In attempting to popularise the subject with a view to increasing the number of workers in the same field, it is hoped that no sacrifice of the purely scientific side has been made.

I wish to record my indebtedness to the many entomologists who have so ungrudgingly given me the benefit of their experience. Notes of occurrences,

or lists of localities, were supplied by Rev. J. E. Tarbat, Messrs. C. A. Briggs, J. J. F. X. King, G. T. Porritt, J. Arkle, W. J. Ashdown, H. J. Turner, A. H. Hamm, R. C. Bradley, W. H. Harwood, M. Burr, O. Whittaker, S. A. Blinkarn, A. M. Rodger, and many other friends and correspondents, as well as by the magazines. The account of the habits and distribution of the Scottish Dragonflies are due to a great extent to the information supplied by Messrs. King, Briggs, and K. J. Morton; while most of the Irish localities were obtained from the excellent paper of the first on the "Neuropterous Fauna of Ireland," published by the Natural History Society of Glasgow. Photographic assistance in connection with several figures was rendered by Mr. F. N. Clarke, and in two cases by Mr. J. J. Collings, while Mr. F. Enock supplied the figure of a hymenopterous parasite in Dragonflies' eggs. For the loan of some of the scarcer British species I am indebted to Messrs. R. McLachlan, J. J. F. X. King, and S. L. Mosley. But especially am I under obligation to Messrs. C. A. Briggs and W. D. Drury for devoting a large amount of time to examining the proof-sheets, to Mr. R. McLachlan for valuable information on the nomenclature, and to Mr. W. F. Kirby for assisting me with many of the scarcer books on the subject at the Natural History Museum, S. Kensington, especially in connection with the synonymy. His own work on this subject—"A Synonymic Catalogue of Neuroptera Odonata"—has been freely consulted.

Although, compared with the *Lepidoptera*, the *Odonata* have received but scanty attention in the

Magazines, yet many articles and notes from the pens of the above-named, and other Neuropterists are scattered throughout them, and much information from them has been embodied in the present work. It is to be expected that as time goes on such notes will become more frequent, and it is the Author's hope that such an increase may take place as to make a new edition of the present work a necessity in the not very distant future.

W. J. LUCAS.

KINGSTON-ON-THAMES,
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BRITISH DRAGONFLIES.

CHAPTER I.

INTRODUCTION.

INCLUDED within the somewhat heterogeneous assemblage of insects usually brought together under the natural order *Neuroptera* are several well-defined groups, which ought perhaps to be looked upon as of ordinate rank in themselves. One such group is that known scientifically as the *Odonata*,* so named, no doubt, by Fabricius† on account of the toothed mandibles of the insects comprising it.

Amongst country people and others, who have bestowed on these insects but a passing attention, names indicative of dislike or fear seem always to have been given as the result of their cursory notice. "Dragonflies," in consequence of their brilliant, scaly armour; "Devil's Darning Needles," in allusion to their long, pointed body;

* Greek, ὀδούς, ὀδόντος = a tooth; though, seeing that the stem of the word is ὀδοντ, one would have expected *Odontata*.

† Fabr., Ent. Syst. ii., p. vi., 373, 1793.

"Horse-stingers," owing to the custom of the rustic mind to jump at conclusions, and think ill of the little-known —such are the opprobrious titles that in common parlance have been bestowed upon some of the most beautiful, and at the same time least understood, of British insects.*

"Dragons," indeed, are the larger kinds to the multitude of smaller insects, whose life is not seldom cut short to provide them a meal. The second name is clearly but an indication of dislike; and to anyone acquainted with the habits of Dragonflies, a reason need scarcely be given for the bestowal of the third name, for they have a way, when handled, of turning the tip of their abdomen under them in a very threatening manner. As, however, no vestige of a sting exists, they are, of course, perfectly harmless in that respect, though they often make attempts, more or less unsuccessful, to bite the hand that holds them. Still, they may be handled without fear, as their jaws are but little adapted for attacking an extended surface.

Neglected though this group of insects has always been by the majority of entomologists, yet it is really an extremely interesting one, not only because the individuals comprising it are often large and always beautiful, but also because in their life-histories there is many a gap which it should be the pleasing duty of the entomologist to fill up. That he will find more difficulties in his work than those which confront the butterfly- and moth-collector, cannot be denied; as, however, difficulties only spur on the genuine naturalist to overcome them, we shall find here but another

* Calvert says that in Philadelphia they are also popularly called Snake-doctors and Mosquito Hawks. (Trans. Am. Ent. Soc. xx., 1893.)

argument in favour of exploring this neglected little corner of the Animal Kingdom.

Some of the difficulties to be encountered by the naturalist who makes Dragonflies his study, are the extremely obscure manner in which their early stages are passed (the nymphs, as the immature form is called, being aquatic), the inconveniences that attend the search for them in those stages, and the breeding and identification of them after they have been found. In making a collection of the perfect insects a further difficulty arises—in connection with their colour-preservation—and, it must be confessed that, however great the care employed, some dissatisfaction is bound to be felt, when, with the life, departs the greater portion of the splendour which places the majority of these insects among the most beautiful of living objects to be found in Nature.

Hunting for the perfect insect has much to recommend it to every true lover of the country, for, since all Dragonflies (except one or two large ones, which sometimes hawk about in the twilight) move only as a rule in fine sunny weather, their capture will always be associated with those bright summer scenes which seem to take so strong a hold upon the memory. The recollection is of beds of tall reeds and stalwart bulrushes fringing the still, sleeping waters of some boggy lake or pool on a hot summer's day, when the trees that grow around are repeated upside down in the glassy surface of the water, and the presence of the azure-tinted Dragonfly, *Anax imperator*, may be traced by his reflection as he hovers o'er the pool, or swings backwards and forwards along the edges of the reed-beds, for a long time tantalising the patient collector

with a distant sight *only* of his beauty; till, growing less cautious, he moves a little out of his usual track, approaches too near his watchful foe, and exchanges his freedom in the bright sunshine for the narrow limits of the collector's net.

Or, maybe, a picture arises of some forest stream o'erhung with the luxuriant foliage of ash and alder, where the current, rippling over its stony bed, sprinkles the bright green ferns and other plants that clothe its shady margins—even such a stream as the well-known Lymington River, where it wanders through some of the wildest and most beautiful parts of the New Forest, often in its meanderings almost lost amongst the thick and tangled vegetation that is found along its course. Such is the home of the gorgeous blue-winged "Demoiselle," or "King George"; * without doubt the most resplendent of our Dragonflies, if not of all British insects. Handsome enough it looks in the cabinet; but to be seen at its best it must be watched as it flutters along the streams in the patches of sunlight that filter through the foliage, and in which its colours vie with those of the kingfisher, whose lovely haunts it shares.

Or yet another scene of an entirely different nature arises in the mind—lengths of flowery ditches, or peaceful slumbering streams, stretching through world-old meadowlands—such streams as are Thames' tributaries in some of the more fertile parts of many-featured Surrey. Here in June, while summer is young and vegetation fresh and green, when the shallow margins of the streams are bands of gorgeous blossoms, and the banks are knee-deep in luxuriant grass and

* *Calopteryx virgo.*

flowers, the smaller Dragonflies, dressed in hues of vivid blue or crimson, sometimes rise in countless swarms before the footsteps of the astonished invader of their realms.

To some the search for Dragonflies may appeal for another reason. Even more than is the case with other insects, there is a tantalising uncertainty as to what may be the result of a day's collecting. *Anax imperator*, *Orthetrum cancellatum*, or several other desiderata may be on the wing and perfectly well in evidence, but the end of the day may find the collecting-boxes quite innocent of specimens. This uncertainty it is which gives the zest to fishing, hunting, and similar sports, and which adds a perfectly legitimate interest to the collection of all kinds of natural objects, where the specimens are obtained by the collector's own personal exertions in the field, and not by the length of his purse.

Of Dragonflies—the British examples at any rate—it may pretty safely be affirmed that they are enemies to no one, notwithstanding the panic that the uninvited presence of a large specimen sometimes creates. On the contrary, they must be looked upon as being eminently useful from the immense numbers of other insects they destroy, their food being entirely of an animal nature in all stages of their existence; and they are the more useful in that they will not touch anything that is not actually living and moving. The fisherman may possibly object to so general a statement with regard to their innocence, and perhaps it is true that certain nymphs may feed on the very young fry of fish if they can catch them, though there is little doubt that on

occasion nymphs may become prey for fishes in their turn. Certainly Dragonflies themselves cannot be put to any direct use, except to give pleasure to all who see them with an unprejudiced eye, whether at large or in the collector's cabinet, although we are told that in Lombock certain large species are caught by means of limed twigs, and used as food.*

What natural enemies the Dragonflies have in this country will usually be found amongst the birds, and their number is no doubt small;† nor, except when they are newly on the wing and their bodies are soft, do they seem to offer many temptations even to the most hungry of foes; whilst the larger species might easily terrify any but the boldest. Gilbert White, the naturalist of Selborne, says,‡ however, that he more than once saw cuckoos catching them, sometimes on the wing, sometimes when the Dragonflies were settled on the weeds. In one instance he notes that the insects had but just emerged from the nymph-case. A German writer, Bechstein, confirms this statement.§ Mr. T. H. Briggs relates that he once saw a fight between a large Dragonfly and a sparrow in a London street, but that the insect came off victorious. It also seems to be the case that the smaller kinds of Dragonflies are at times devoured by hobbies, kestrels, and swallows.‖ That they some-

* W. R. Wallace, "Malay Archipelago," p. 154, 1877.

† By some, however, it is thought that birds cause considerable havoc amongst Dragonflies. McLachlan (E. M. M., vol. ix., p. 48) mentions that a bird, *Merope persicus*, lines its nest with the remains of Dragonflies, on which insects it apparently feeds.

‡ "Natural History of Selborne," Letters vii. and xxx. to Hon. Daines Barrington.

§ "Gemeinnutzige Naturgeschichte Deutschlands" (1805).

‖ E. M. M., 1871, p. 190; id. 1872, p. 227.

times eat one another cannot be denied, for the writer has more than once caught a large Dragonfly in possession of one of its smaller brethren, and on one occasion watched—indeed, was the cause of—a striking piece of cannibalism.* There fell to the net a male *Anax imperator*, which had just before captured a *Sympetrum scoticum*—the small black Dragonfly. This it almost killed, but released in the net. While *imperator* was held by the wings, another *scoticum* was offered, which it seized with its legs, but after biting let fall also. On *scoticum* being offered a second time however, all except the wings and part of the abdomen was quickly devoured with evident pleasure. It should be mentioned that *scoticum*, being but just on the wing, was soft and tender. On another occasion a *Libellula quadrimaculata* was secured eating an example of the crimson Dragonfly, *Pyrrhosoma nymphula*;† and Mr. W. J. Ashdown mentions the fact of his having taken in the New Forest a specimen of *Gomphus vulgatissimus* also making a meal off an individual of the same small species. Some large insects, probably a species of *Asilus*, have been noticed preying on Dragonflies in California.‡

Coming to smaller foes, acari, or tiny red spider-mites, are sometimes found as external parasites, and are occasionally so closely packed on parts of the wings as to mark them with red. The genus *Sympetrum* seems to be most commonly attacked, and in *S. meridionale* they are said to be almost looked upon as a specific character.§ What nutriment they can extract from a

* Entom., 1897, p. 281. † Entom., 1897, p. 33.

‡ R. McLachlan, Entom., 1873, p. 549.

§ R. McLachlan, E. M. M., 1864, p. 100; id. 1884, p. 252. C. A. Briggs, id. 1892, p. 194.

Dragonfly's wing it is difficult to say! A similar parasite has been noticed by the author on the thorax of *Pyrrhosoma nymphula*,* and on that of *Ischnura elegans*.

The Sundew (*Drosera*), into whose economy Darwin has entered so fully in his "Insectivorous Plants,"† sets a trap of gum-tipped glands, and sometimes secures such large game as the small blue Dragonflies by entangling their wings amongst its tentacles. A single plant of *Drosera rotundifolia*, growing by the side of a pond in the fir-woods near Esher, was once found having caught no less than four specimens—three living males of *Enallagma cyathigerum* and one dead female, no doubt of the same species.‡

Generally speaking, Dragonflies must be sought for near water, especially lakes, ponds, slow streams, and ditches, not only because their eggs are deposited and their young live in that element, but also because in its vicinity insect-life—and therefore food—is usually more abundant than elsewhere. Nevertheless they are often found a considerable distance from water, and in some cases, soon after emergence and before their colours are mature, seem to prefer to keep away from its immediate neighbourhood.

Very limited powers of flight are possessed by the smaller Dragonflies, and in consequence they do not wander far from home; and even the larger ones, whose flight is as powerful as that of the others is weak, usually confine their journeyings to a very restricted range. But on occasion a few species for

* Entom., 1897, p. 283.

† *Vide* 2nd edition, chap. i., p. 2.

‡ Entom., 1896, pp. 99, 257.

some unknown reason (perhaps scarcity of food or dearth of water) develop a migratory instinct, and wander in countless swarms for long distances: on several occasions they have been noticed far out to sea. Among British Dragonflies, *Libellula quadrimaculata* (the Four-spotted), has this trait very well developed, and many flights have been noticed.

Geologists tell us that the Dragonflies are a very ancient group of insects, and, possibly because their outer covering is somewhat hard, their remains are fairly numerous. In fact, representatives of the *Neuroptera* are amongst the oldest of fossil insects yet known. The earliest traces of insects were discovered near St. John's, in New Brunswick, in the upper portion of the Old Red Sandstone system, and consisted of a few broken wings of *Neuroptera* allied to the *Ephemeridæ*, but perhaps having some features in common with the *Orthoptera*.* The earliest fossil remains that can with certainty be referred to the Dragonflies, have been found in the Lower Lias of the Jurassic system, this formation in the West of England having provided a great number of specimens. The Stonesfield Slate of the Lower Oolite and the Purbeck beds of the Upper have also been fertile sources of supply in England. But perhaps the formation best known for supplying fossil Dragonflies in large numbers is the Solenhofen Slate of Bavaria. This formation supplied the fine specimen of *Cordulegaster dresdensis*, Charp. (*Æschna charpentieri*, Hagen), which Charpentier has depicted in his well-known text-book.† The Tertiary series

* "Geological Antiquity of Insects," by H. Goss, pp. 6, 12, &c.

† "Libellulinæ Europææ," by T. de Charpentier, pl. 48, fig. 1, 1840.

also afford numerous specimens of fossil *Odonata*, but the Post-Tertiary, although gradually gliding into recent formations, are singularly wanting in Neuropterous remains. Kirby enumerates 103 species of fossil *Odonata*.*

Of recent Dragonflies, Linnæus knew only fifty-six species in the middle of last century. Baron de Selys Longchamps gave 1344 as the total in 1871. In 1890 Kirby could bring the list up to 1800, and thought that the number might be quadrupled if only the group were more thoroughly worked. The total for Europe is just over a hundred, while in Britain there are forty, one of which, however, *Sympetrum fonscolombii*, and probably another, *S. flaveolum*, are only occasional visitors, whilst a third, *S. vulgatum*, if present at all, can with difficulty be distinguished from *S. striolatum*. Of the remaining thirty-seven, one or two are so rare that a locality can scarcely be assigned for them, but the majority of the rest one might fairly expect to catch in two or three seasons by collecting in various districts. In addition to the forty referred to, there are seven species that are recorded as having occurred a long time since, usually as single specimens, and in one case at least with very doubtful authenticity. Not one of these can be looked upon now, at any rate, as British species. Whether others remain to be discovered in the British Isles cannot, of course, be said; but the likelihood does not seem great, and it must be confessed that in all probability future changes in the total number of species of British Dragonflies must be looked for in the way of decrease only.

* "Synonymic Catalogue of Neuroptera Odonata," by W. F. Kirby, 1890.

CHAPTER II.

LIFE-HISTORY.

Watch the surface of a boggy pool on a bright summer or autumn day, and it will be strange if females of *Sympetrum striolatum* are not to be seen busily engaged in the act of ovipositing. This they accomplish by repeatedly dipping the extremity of their abdomen in the water, and on each occasion dropping one or more eggs. The male of this species usually accompanies the female, and, by clasping her at the neck with the anal appendages at the extremity of his body, perhaps assists in keeping her poised above the water. This attachment of the male to the female, *per collum*, as it is called (Fig. 1), is really the first step in striking up an amatory acquaintance, but is not immediately concerned in the fertilisation of the ova, which is accomplished in a somewhat peculiar manner. The ninth segment of the abdomen of the male bears on the ventral surface the organs of secretion of the fertilising fluid, which by curving his abdomen under he removes to a receptacle in the second segment. While the female is held *per coll.* by the male she bends her abdomen round in such a way that the ninth segment is applied to the second

of the male, and in this way the eggs are fertilised. No doubt fresh batches of eggs need to be separately fertilised, necessitating the continued attendance of the male upon the female; but perhaps the proceeding may also be looked upon as an act of fidelity, akin to that of the earwig for her eggs, and, according to De Geer,



FIG. 1.—LESTES SPONSA, MALE AND FEMALE CONNECTED PER COLLUM.

for her young—a trait not often exhibited thus low in the Animal Kingdom.

But the males of all species are not so attentive as those of *S. striolatum*, nor are the eggs in all cases so carelessly laid. Instances have been noted—*e.g.*, by Messrs. B. J. Clarke, J. Jenner Weir, and G. W. Dunn—that when members of the genus *Agrion* are ovipositing,

the male, which has been previously flying with the female, sets her free on a blade of grass or a rush, and that she then goes down below the water, and deposits her eggs. The author has observed the same proceeding in the case of *Enallagma cyathigerum*. A similar habit was noticed by Von Siebold in the case of the genus *Lestes*.* Mr. McLachlan found in Savoy (1884) *Agrion*



Fig. 2.—Pyrrhosoma nymphula Ovipositing within a Leaf of Potamogeton.

mercuriale with its abdomen encrusted with mud through ovipositing where water was almost dried up, and in 1895 the same observer discovered *Pyrrhosoma nymphula* laying its eggs in a nearly dry ditch in the New Forest.†

* E. M. M., 1873, p. 163. "Neuroptera austriaca," by Brauer und Löw, p. xiv.

† E. M. M., 1895, p. 180.

On July 24, 1898, a pair of *Pyrrhosoma nymphula* were noticed near Esher, in Surrey, flying connected *per coll.* Presently the female settled on a floating leaf of *Potamogeton*, while the male poised itself on the wing with its body vertical. The female was then noticed to be moving the extremity of her abdomen along the upper surface of the leaf. This was picked,



Fig. 3.—Æschna grandis Ovipositing.

and after careful search, when somewhat withered, the eggs were found below the upper cuticle (Fig. 2). In the New Forest, on August 4, 1898, a pair of *Platycnemis pennipes*, united *per coll.*, were seen resting on a yellow water-lily blossom, and the female was moving the anal extremity of her abdomen along the

surface of the stem, no doubt in this case also inserting eggs in it, but they could not be discovered.

On September 11, 1898, *Æschna grandis* was noticed ovipositing in shallow water, close to the edge of one of the large ponds in Richmond Park. This it did by settling on a floating weed, or one that was but little exposed, and then bending the abdomen so as to dip its extremity into the water. This appeared to be done deliberately, as if the eggs were being carefully placed (Fig. 3).

On more than one occasion, when *Æschna juncea* was seen busily engaged in oviposition, it seemed as if she rested on the surface of the water, or perhaps rather on a weed that was just submerged, while laying her eggs; but whether she dropped them at random, or deposited them in a selected position, was not clear. There is, however, no reason to doubt that in common with other Dragonflies which possess ovipositors, this one places them within the surface of a plant.* It seems to be the habit, on the other hand, of the *Libellulidæ*, which possess no ovipositor, to drop the eggs into the water in a very unstudied manner.†

If the eggs are examined under a microscope of sufficiently high power it will be at once noticed (see Fig. 4) that there are two kinds—the more or less elliptical, and the elongated; and it is perhaps more than a coincidence that the broad-bodied Dragonflies and their relatives without ovipositors (some of whose bodies, however, are not broad) have elliptical eggs, while the essentially long-bodied Dragonflies — the *Æschninæ* and the *Agrionidæ*—possessing ovipositors—

* Entom., 1894, p. 296; 1897, p. 34. † Entom., 1897, p. 280.

have long eggs. Most of the eggs represented in the figure possess a little stalk, or pedicel, of attachment; but as nearly all the drawings were made from eggs



FIG. 4.—EGGS OF VARIOUS SPECIES OF DRAGONFLIES.

1. ÆSCHNA JUNCEA (× 24).
2. SYMPETRUM STRIOLATUM (× 48).
3. LIBELLULA DEPRESSA (× 30).
4. LIBELLULA QUADRIMACULATA (× 30).
5. ANAX IMPERATOR (× 24).
6. ENALLAGMA CYATHIGERUM (× 25).
7. PYRRHOSOMA TENELLUM (× 25)
8. ÆSCHNA MIXTA (× 24).
9. SYMPETRUM SCOTICUM (× 30).
10. ORTHETRUM CÆRULESCENS (× 30).
11. CORDULEGASTER ANNULATUS (× 24).

extracted from the dead bodies of the females, this pedicel may not always belong to the egg proper, especially as that of *S. striolatum* (No. 2), which was laid naturally, has not got it. The eggs themselves are smooth and nearly colourless, but have just a yellow tint. The contents are granular, and, no doubt, consist to a great extent of protoplasm, with possibly some oily globules. At any rate, their appearance gives one that impression. Though so small (and the largest, that of *Anax imperator*, of which No. 5 (Fig. 4) is an illustration, is but $1\frac{2}{3}$mm.* in length), Dragonflies' eggs have parasites we are told. A tiny hymenopterous insect, of the family *Mymaridæ*, passes its early stages in them. Mr. F. Enock, who makes a study of these minute creatures, says that he has bred from Dragonflies' eggs many specimens, both male and female, of *Anagrus incarnatus*, one of these minute Mymarids less than $\frac{1}{2}$mm. in length. These Fairy-flies, as they are called in the vulgar tongue, when they leave the Dragonfly's eggs as perfect insects, use their curious wings to swim to the surface of the water, where, owing to their microscopic size, it is difficult to find them (Fig. 5).

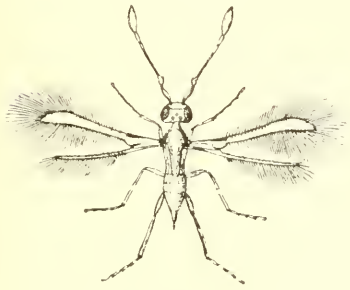


Fig. 5.—Anagrus incarnatus.
(After F. Enock.)
Parasitic in Eggs of Dragonfly.
(Greatly magnified.)

* It has seemed well in most cases to make the millimetre the unit of length, not only because its value is understood in all civilised countries, but because many measurements we have to make are so small that an inch becomes unwieldy. For practical purposes 25mm.=1in.

To obtain a general idea of the early life of a nymph, it will be convenient to take a particular insect. If attention is again directed to the egg of *Sympetrum striolatum* (Fig. 4), it will be seen that the nymph is nearly formed, and almost ready to hatch out. The batch of eggs to which this belonged was laid about September 15, 1896. On October 18, they were examined,

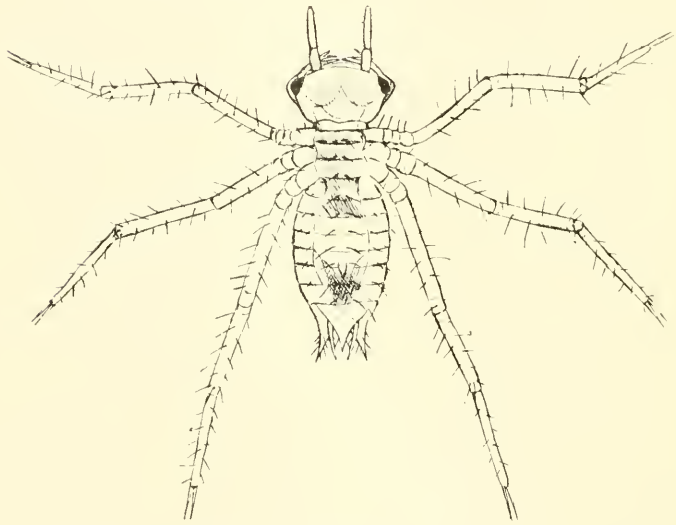


Fig. 6.—Newly-hatched Nymph of Sympetrum striolatum.
(× about 45 diameters.)

after having been unnoticed for two or three days, and a considerable number had hatched. The little nymphs, which were about 1mm. long, resembled tiny spiders swimming about in the water (Fig. 6). They were extremely transparent, the head, thorax, and abdomen being slightly tinged with yellowish-green, the rest

of the animal being colourless. The legs were very long. As they managed to live practically without food for two or three weeks, they must be rather hardy. About December 15, they were placed in a small fish-globe, in which weeds were growing, and amongst which they no doubt found some food. On March 21, 1897 (*i.e.*, about five months after they were hatched), a few were still living, and the largest was about four or five millimetres in length. It was then very difficult to find them, as they closely resembled the mud at the bottom of the fish-globe in which they lived. On October 1, 1897 (almost a year after they were born), there was but one survivor, though it is more than probable that a good number of its brethren had entered into its composition. In length it was now about 16mm. The wing-cases appeared full-grown, and no doubt the summer of 1898 would have witnessed the consummation of its existence, had it not somewhat unaccountably disappeared towards the end of the year.

How long this imperfect condition of Dragonfly existence lasts is extremely doubtful. It used to be thought that some of the larger species required three years to reach the final stage. They may take as long when the food-supply is scanty, but in all probability it will be found that the majority complete the cycle of existence within the year, even if one or two of the small species, *e.g.*, *Enallagma cyathigerum* and *Ischnura elegans* have not a second emergence about September. At any rate, in that month they are often found—the females especially—with what appears to be the immature colouring, although, of course, it does not follow that they are the offspring of Dragonflies that emerged earlier in the same season.

But this portion of the subject is involved in much doubt, and, like the identification of many of the nymphs, requires close observation and careful, steady work.

As with the larvæ of *Lepidoptera*, changes of skin (ecdyses) occur, and after one of these we find that the nymph, which in Fig. 6 is seen to be quite destitute of wings, has developed on the thorax little processes, which, as successive changes of skin take place, gradually assume the appearance of wings; but even during the last nymph stage they are very small indeed compared with their size in the perfect insect. On account of the wings appearing in this way, and the further fact that the nymph is active and feeds in all stages, the imperfect Dragonfly gradually approaches in appearance the imago; and so those startling metamorphoses, with which we are so familiar in butterflies and moths, are absent to a great extent in these insects. How often ecdyses occur it is difficult to say, but probably a considerable number of times. The period between the last two corresponds perhaps most nearly to the pupal stage of *Lepidoptera*, *Coleoptera*, &c., the period before—that of growth—to the larval condition of those insects.

When a nymph is full grown, and the appearance of the perfect Dragonfly is near at hand, it appears to cease feeding and to take little interest in life. Perhaps the former is impossible, for great changes must be taking place inside the skin. Some impulse now causes it to seek the upper air, and the hitherto aquatic and ugly, sombre-tinted nymph ascends the stem of a reed or rush, or crawls up anything, in fact, which will enable it to leave its watery home. Up this reed, or possibly

some neighbouring wall or fence* it climbs till it is well out of the water, and also clear of any objects that might touch and injure it during the coming change. Here it remains for a while, perhaps for an hour or two, clinging, head upwards, to the support it has chosen Fig. 7). At this period of its life the thoracic spiracles are often conspicuous, and no doubt it breathes atmospheric air through them, as perhaps it did just before leaving the

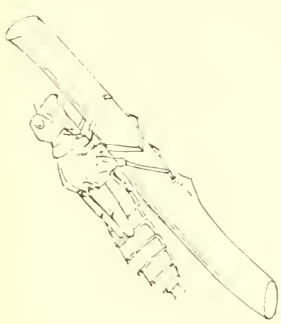


FIG. 7.—NYMPH OF LIBELLULA QUADRIMACULATA, READY TO DISCLOSE IMAGO.



FIG. 8.—IMAGO OF LIBELLULA QUADRIMACULATA PARTLY OUT OF THE NYMPH-CASE, AND IN "RESTING" POSITION.

water, for when the great change is near it likes to keep the fore-part of its body out of the water.

* In 1897, near Byfleet, several empty nymph-cases of *Calopteryx splendens* were found on walls, to get to which the nymphs must have crossed the canal path; and Mr. Bell-Marley found an empty case of an *Æschna* (probably *cyanea*) on a high railing, to reach which the insect must have crawled ten yards or more. The absence of reeds was no doubt the cause of this long journey. Mr. Wattson also noticed the same thing in Richmond Park. In confinement nymphs often become restless, and get out of the vessels in which they are placed, especially when they are nearly full grown.

When the skin is dry, it cracks across the head, longitudinally along the dorsal surface of the thorax, and transversely just in front of the wings, and the thorax and head of the imago emerge. The wings follow, and the legs are gradually drawn out; then the fore-part of the body usually falls backwards,* as if the insect was exhausted and could not complete its emergence (Fig. 8). In this position of rest, from which it seems likely to fall into the water at any moment, it remains for some time—say a quarter of an hour to an hour, according to the size of the insect, and perhaps other circumstances. After gathering strength, it may be from this rest, and the legs possibly having hardened, with a sudden effort it curves its body forward and up to the now empty thorax of the nymph-case, draws out the end of its abdomen, and is thus seen hanging to the empty case, which still retains its hold upon the rush, or whatever the support may be, and in this way, to adapt the words of Tennyson, the insect appears to

> " . . rise on stepping-stones
> Of its dead self to higher things." †

The newly-disclosed imago is of a nearly uniform dingy, brownish-yellow tinge, retains much the shape of the nymph, and possesses the tiniest of opaque wings (Fig. 9). But let him who has watched thus far watch still more closely now! The higher animals develop gradually and continuously, but insects

* In the case, however, of an emergence of *Pyrrhosoma nymphula*, closely watched throughout, the imago did not fall back at all, but kept the fore-part of its body erect during the resting period. An *Agrion puella* caught in the act of emerging was at the time also resting with its body erect.

† "In Memoriam," i.

at certain periods in their existence do so suddenly and rapidly, and the present is one of the most striking instances of it. The wings are seen to be expanding at the base, and this expansion slowly proceeds till after half an hour or so it has reached the tip and the wings are of their full size, though still yellow and opaque. This process is accompanied by



FIG. 9.—IMAGO OF LIBELLULA QUADRIMACULATA, JUST EMERGED AND HANGING TO THE EMPTY NYMPH-CASE. WINGS BUT LITTLE DEVELOPED.



FIG. 10.—IMAGO OF LIBELLULA QUADRIMACULATA, LATELY EMERGED. WINGS FULL-GROWN, BUT NOT YET EXPANDED.

twitchings of the abdomen from front to back, while in some cases it is at intervals bent forward at the tip and then contracted lengthwise, as if air was being forced from it into the wings, which perhaps is the case, for they consist of two layers which seem to be slightly separated during the progress of the metamorphosis.

The wings are at this stage extremely delicate, and if scratched green blood flows from them freely. While they are thus tender, the insect curves the end of its abdomen backwards to prevent any foreign substance from injuring them. Later on, when the two layers have become cemented together, the wings may be damaged to any extent apparently without causing trouble to their owner, except that its power of flight is in consequence to some extent impaired. The elongation of the abdomen takes place chiefly after the wings are fully expanded (Fig. 10).

When all parts have attained their full size a further rest occurs, the wings in all cases observed being kept adpressed to one another, as in the usual resting position of the Zygopterids: an Anisopterid, however, expands its wings after a time, when the cloudiness has passed away from them. If emergence takes place in the morning, as it often does, the new-born Dragonfly, as soon as the sun is well up in the sky, tempts the air with weak and feeble flight, its wings glistening with a glassy sheen and its body wanting the gorgeous colours which make a Dragonfly what it is. This period, during which the imago is said to be *immature*, is of varying duration. It always lasts at least a day or two, and in some species, especially amongst the *Libellulinæ*, a much longer period elapses before the perfect insect appears in its fullest splendour, till which time there is often a disposition to move away from the presence of water. But at length the sheen disappears from the wings,* the full

* Mr. C. A. Briggs has a specimen of *Orthetrum cancellatum*, from Wisley, in which the principal nervures of one fore-wing are broken. This wing retains the glassy immature condition. The other three wings

colouring is assumed, and the Dragonfly is ready to wander to and fro above the streams and ponds, there to hawk for its prey and to seek for, or be sought by, its mate, reminding us of Tennyson's exquisite lines in the "Two Voices":

> "To-day I saw the Dragonfly
> Come from the wells where he did lie.
>
> "An inner impulse rent the veil
> Of his old husk; from head to tail
> Came out clear plates of sapphire mail.
>
> "He dried his wings: like gauze they grew;
> Thro' crofts and pastures wet with dew
> A living flash of light he flew."

Soon the serious business of life—that of reproducing the species—is entered upon, and usually in about three months—sometimes less, sometimes a little more—the Dragonfly's life is ended. There is, however, a small brown Dragonfly, *Sympycna fusca*, found on the Continent of Europe, but not so far discovered in Britain, and probably not to be found here, which winters in the perfect form, when the weather is not too severe, hiding in the heather, and coming out in the winter sunshine to remind us of the summer that is gone, and to be an earnest of that which is to come.

are quite mature in appearance. The inference would seem to be that "maturity" is caused by *use*, not merely by *age* or *exposure*. All four wings must have been equal in *age* and *exposure*, but only the three uninjured ones had had actual use.

CHAPTER III.

CLASSIFICATION.

That the Dragonflies are insects is, of course, at once apparent—they are segmented, and the body is distinctly divided into head, thorax, and abdomen, the thorax bearing in the adult form four wings and six legs. But considerable difficulty arises when the attempt is made to find them a home in one of the natural orders into which insects are usually divided. No doubt most entomologists take up the position that they constitute a subdivision of the rather nondescript order *Neuroptera**, though many incline to the view that they are of ordinate rank in themselves, while a few would attach them to the *Orthoptera*, which order they approach in several respects.

For exponents of the last view we must usually look to Continental writers: it does not find favour with British naturalists, though in the mouth structure and in their incomplete metamorphosis—that is, the want of a clear line of demarcation between the larval and pupal stages—Dragonflies certainly bear a resemblance to the *Orthoptera*. Should it be necessary, however, to bring

* Greek νεῦρον = a nerve; πτερόν = a wing.

about this connection, the newer term, *Orthoptera*, would probably have to be dropped in favour of the older one, *Neuroptera*, of which order Linnæus seems to look upon the Dragonflies as the type.

Seeing that but a small proportion (perhaps not more than one in ten) of the *Neuroptera* of the world have come under the examination of entomologists, and that the life-history of but few even of these has been studied, it seems best to adopt the older view of the order, and look upon the Dragonflies as part of the *Neuroptera*, using the term in the oldest sense as employed by Linnæus. Later, when more individuals have been discovered, their life-histories worked out, and their affinities established, it may be found necessary to break up the order, and possibly to place the different parts of it more satisfactorily.

So heterogeneous are the groups of insects comprising the order that it is not easy to draw up a comprehensive list of characters possessed by the whole. The order *Neuroptera* may, however, thus be diagnosed: *Metamorphosis complete or incomplete; mouth of imago mandibulate, that is, suited for biting; wings (sometimes not present) four, similar in texture, naked (or hairy), usually with a close net-work of nervures; abdomen never armed with a sting.*

It now becomes necessary to sub-divide the order—a by no means easy task. McLachlan* does so as follows:

1. *Pseudo-neuroptera*, containing the Psocidæ, Perlidæ, and the Ephemeridæ, or Mayflies.

*A catalogue of British Neuroptera, published by Entom. Soc. of London, 1870.

2. *Odonata*, or Dragonflies.

3. *Neuroptera-planipennia*, containing the Sialidæ, or Alderflies; Raphidiidæ, or Snakeflies; Osmylidæ; Hemerobiidæ; Chrysopidæ, or Lacewings; Coniopterygidæ; and Panorpidæ, or Scorpionflies.

4. *Trichoptera*, or Caddis-flies.

The *Mallophaga*, or Bird-lice, &c., are by some added to the *Neuroptera*, and if so they form a first division in front of the Psocidæ. The Embiidæ and Termitidæ, or white ants (neither of which is represented in Britain), fall into the *Pseudo-neuroptera*. The Perlidæ, Odonata, and Ephemeridæ are sometimes united under the name of *Neuroptera-amphibiotica*, the nymphs of all of them being aquatic.

Brauer, in a system of classification of insects proposed in 1885,* divides them into seventeen orders, and of these seven are made from the *Neuroptera* as usually understood, while the Embiidæ form part of an eighth—the *Orthoptera*.

The seven are:

1. Ephemeridæ.
2. Odonata.
3. Plecoptera (= Perlidæ).
4. Corrodentia (= Termitidæ, Psocidæ, and Mallophaga).
5. Neuroptera (= Hemerobiidæ and Sialidæ).
6. Panorpatæ (= Panorpidæ).
7. Trichoptera.

* "Syst. Zool. Studien," Wien, 1885.

Next year (1886), Packard published in the *American Naturalist** a somewhat similar scheme. He makes sixteen orders, our *Neuroptera* being distributed amongst six, as follows:

1. Platyptera (= Termitidæ and Mallophaga).
2. Odonata.
3. Plectoptera (= Ephemeridæ).
4. Neuroptera (net-veined insects, with metamorphosis complete).
5. Mecaptera (= Panorpidæ).
6. Trichoptera.

So distinct are the *Odonata*, even from their nearest allies—the *Ephemeridæ* — that it seems almost necessary to give them ordinate rank, whether all of the numerous sub-divisions of the *Neuroptera* suggested by Brauer and Packard are finally adopted or not.

The *Odonata* may be described as: *Insects with incomplete metamorphosis, possessing no real pupal stage, and undergoing a great change at the final ecdysis. The nymph is aquatic. The imagines have large eyes, small bristle-like antennæ, head with great capability of movement, and a long body. The four wings are more or less equal and transparent, with the main nervures longitudinal, crossed by numerous transverse nervures, forming an intricate meshwork of cells. The wings are quite posterior to the legs.*

* American Naturalist, xx., 1886.

The *Odonata* may be thus sub-divided :

Super-family ANISOPTERIDES.

Family LIBELLULIDÆ.

Sub-family *Libellulinæ.*
Sub-family *Corduliinæ.*

Family ÆSCHNIDÆ.

Sub-family *Gomphinæ.*
Sub-family *Cordulegasterinæ.*
Sub-family *Æschninæ.*

Super-family ZYGOPTERIDES.

Family AGRIONIDÆ.

Sub-family *Calopteryginæ.*
Sub-family *Agrioninæ.*

CHAPTER IV.

THE NYMPH.

Unlike the *Lepidoptera* and some other groups of insects, the Dragonflies, as previously mentioned, do not pass through three distinct stages of existence—the larva, the pupa, and the imago. They have an "imperfect metamorphosis"; that is, the first two stages are merged into one, and to it the name of *nymph* (or larva-nymph) is usually given. Gorgeous colours and a slender graceful form, accompanied often by rapid flight, would probably be looked upon as especially distinctive of a Dragonfly; yet in the nymph stage the insect is in general characterised by dingy colouring, slow and laboured movements, and ungainly, if not hideous, form.

The tints assumed range from bright green, through yellowish-green, to brown, or even almost black, usually, but not quite always, unaccompanied by any conspicuous markings. General ground-colour goes for very little, for of two individuals of the same species, especially among the *Agrionina*, one may be bright green and another quite dark brown, and probably the same range of tints may be borne by the same individual at different times. Colouring, in fact, seems

to depend almost entirely on the environment. If a nymph is living on the mud it is brown ; if on a dead stick almost black ; while should it make its home amongst the weeds, it clothes itself in a dress of harmonious colouring—green, and sometimes of the brightest emerald tint. This chameleon-like adaptability to its surroundings no doubt serves a double purpose, that of hiding the nymph from its enemies, and at the same time enabling it, without being suspected, to approach within striking distance of its prey.

Probably also form, no less than colour, conduces materially to the well-being of the young Dragonfly. Those who search for nymphs know only too well how difficult the Æschnas are to distinguish from the broken bark on a water-logged stick, or how well a *Calopteryx* is hidden amidst the roots of the reeds. Amongst the dead leaves and rubbish at the bottom of a pond a *Libellula*, a *Sympetrum*, or a *Cordulia* looks as much like a bit of rubbish as they, whilst an Agrionine amongst the weeds almost defies detection.

Under ordinary circumstances, all nymphs walk slowly, indeed, rather stealthily, amongst the weeds or along the bottom of the pond or stream, but when disturbed or aroused by the near presence of some living creature which appears suitable for food, they can progress in a very different manner and with much greater speed, though the method employed to obtain this exceptional speed is not the same in both of the great divisions of the *Odonata*. To understand this it will first be necessary to examine a little into the structure of a typical nymph from each division (Figs. 11 and 12).

First, with regard to the breathing apparatus, which is of more than ordinary interest, seeing that the earlier part of the insect's existence is aquatic, in which state it breathes the air dissolved in the water, while the second part is aërial. Our knowledge of the respiration of the Dragonfly nymphs is far from complete, but certain facts have been well ascertained. One of these is that the *Libellulidæ* breathe by means of rectal branchiæ. The water is drawn in through an opening between the five anal appendages (Fig. 11, *lat. a.a.*, *l.a.a.*, *u.a.a.*), which are then brought together so as to close the orifice. After the air has been extracted, the water is ejected, and this can be done with such force as to propel the insect through the water at a very considerable pace, and it is by repeating this process that the nymph moves about rapidly, though in a series of jerks. In place of the five-pointed appendages the *Agrioninæ* have three thin blade-like lamellæ (Fig. 12, *c.l.*), which probably assist in respiration as they possess a ramification of tracheæ, but are

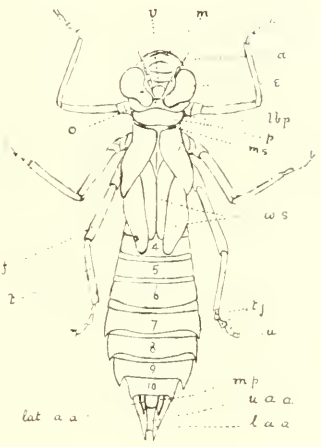


FIG. 11.—NYMPH OF AN ANISOPTERID DRAGONFLY (ANAX IMPERATOR).

m., Mask; *v.*, Vertex; *a.*, Antenna; *e.*, Eye; *o.*, Occiput; *l.b.p.*, Position of Leg-base Processes; *p.*, Prothorax; *m.s.*, Meso-thoracic Spiracle; *w.s.*, Wing-sheaths; *f.*, Femur; *t.*, Tibia; *t.j.*, Tarsal Joints; *u.*, Ungues (or claws); 4-10, Visible Segments of Abdomen; *m.p.*, Male Projection; *u.a.a.*, Upper Anal Appendage; *lat. a.a.*, Lateral Anal Appendages; *l.a.a.*, Lower Anal Appendages.

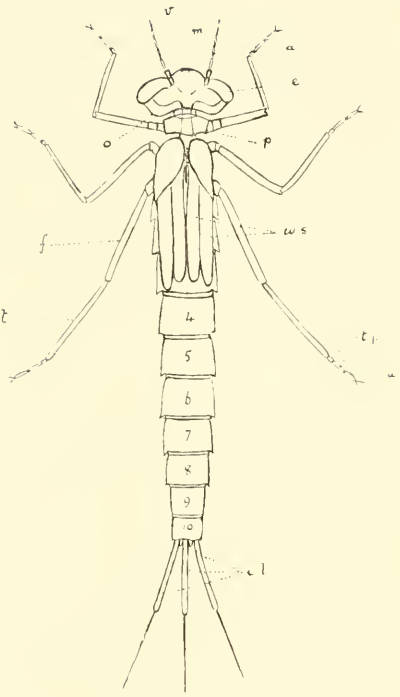


FIG. 12.—NYMPH OF A ZYGOPTERID DRAGONFLY (ERYTHROMMA NAIAS).

(Magnified).

References same as for Fig. 11, except *c.l.*, Caudal Lamellæ.

certainly used as organs of locomotion. Pressing their legs against the body, they sway the abdomen from side to side, and use the lamellæ somewhat as a boatman does an oar at the stern of a boat in lieu of a rudder. In this way the Agrionine nymphs are able to progress at a very fair pace through the water. That they do not breathe entirely by means of the lamellæ is clear, for they often lose them, and live perfectly well without them, but they are not able to move with so much ease through the water, even though they sway their body to a much greater extent.* In the *Calopterygina*, of the three appendages, the central one only is lamellar, but this sub-family seems to be possessed of an

* Dewitz saw under the microscope "a stream of water pass in and out of the end of the intestine" in an Agrionine nymph, and consequently thinks that there may be a rectal means of respiration (Packard's Text-Book of Entomology, p. 464, 484), but breathing is no doubt carried on to some extent through the skin, especially in the younger nymphs.

imperfect rectal respiratory system.* Between the pronotum and the meso-notum in the full-grown nymph will be found a pair of large spiracles (Fig. 11, *m.s.*) (sometimes plainly visible), while another smaller pair occur just above the hind-legs. Immediately before emergence the former pair are probably open, and used for breathing atmospheric air. The eight pairs of abdominal spiracles appear to be functionless during the nymph-stage.



FIG. 13.—SIDE-VIEW OF FORE PART OF A NYMPH WITH MASK *in situ*.

m., Mask; *h.*, Hinge; *t.*, Tip of Mask; *m.h.*, Movable Hook attached to Palpus.

In connection with the structure of the Dragonfly-nymph the most striking point is the mask (Fig. 13, *m.*), a peculiar modification of the labium, or lower lip, by means of which the creature catches its prey. The term *mask* is applied to this structure because it hides the lower part of the face. At rest, with the exception of the tip, the mask is out of sight (Figs. 11 and 12). The base is attached below the mouth; the hinder half lies under the head and fore part of the thorax; there is a joint in the middle, and the fore part lies under the hinder, bringing the base and tip together close to the mouth

* The five anal appendages of the *Libellulidæ* vary much in size and shape, as also do the lamellæ of the *Agrionidæ*. One or two of the latter are to be seen in Figs. 41, 45, 47, and 53, from which it will be noticed that the differences are considerable, and it may be that when more is known of the Agrionine nymphs the lamellæ may be found to be of use in helping to distinguish the species.

(Fig. 13). At the tip of the mask are two movable joints furnished with hooks, with which the nymph holds its prey. These hooks are no doubt the labial palpi, and from their appearance the term *forceps* has sometimes been applied to them (Fig. 14).



Fig. 14.—Forceps (=Labial palpi) at Tip of Mask of Anax imperator.

(Much magnified.)

From Fig. 15 it may be seen how the mask varies in shape, especially in the anterior part, in the different sub-families. The way in which this interesting organ is employed is sufficiently striking. When a tiny red worm or other apparently dainty morsel is sighted, the nymph stealthily creeps along, step by step, so as not to excite the attention of its prospective prey. Arrived within measurable distance, which, judging from its

false shots, it does not seem able to gauge very accurately, the nymph puts into motion the powerful muscles by which the mask is moved, shoots it out

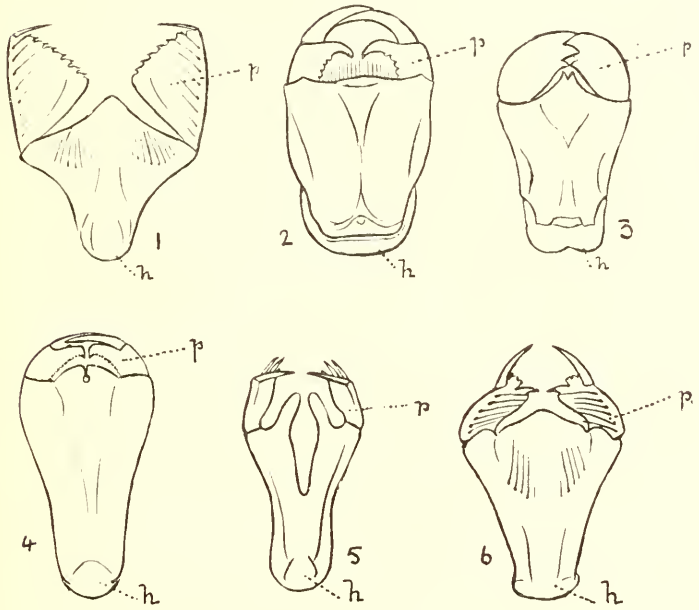


FIG. 15.—TYPICAL MASKS OF THE VARIOUS SUB-FAMILIES.

1. LIBELLULINÆ AND CORDULIIDÆ (*Cordulia ænea*).
2. GOMPHINÆ (*Gomphus vulgatissimus*). (After Cabot.)
3. CORDULEGASTERINÆ (*Cordulegaster bidentatus*). (After Cabot.)
4. ÆSCHNINÆ (*Anax imperator*).
5. CALOPTERYGINÆ (*Calopteryx splendens*).
6. AGRIONINÆ (*Erythromma naias*).

p., Palpus; *h.*, Hinge.

with lightning speed, seizes the animal with the forceps (Fig. 34), and with equal speed brings back the mask with its prey, which is by this means placed

immediately in front of the mouth, where the formidable maxillæ (side jaws, Fig. 16) make short work of it, struggle as it may and often does.

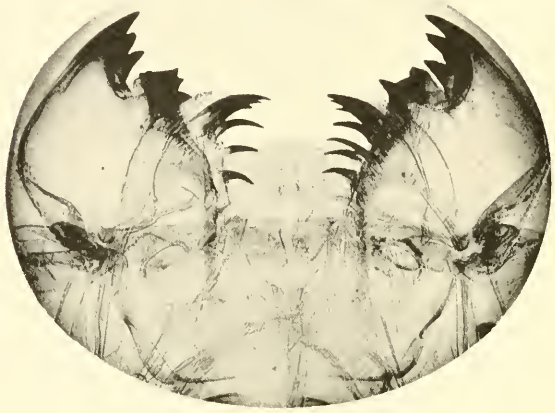


Fig. 16.—Mandibles and Maxillæ of Nymph of Anax imperator.
(Much magnified.)

To complete the references to Figs. 11 and 12, *v* is the vertex or crown ; *o*, the occiput ; *e*, the eyes ; *a*, the antennæ, short and usually consisting of seven joints ; *p.*, the pro-thorax ; *w.s.*, the wing-sheaths. Of the legs, *f* is the femur ; *t*, the tibia ; *t.j.*, the tarsal joints, usually three in number (Fig. 43) ; *c*, the ungues, or claws. The ten abdominal segments are numbered accordingly, the first three being almost hidden beneath the wing-sheaths. Of the five anal appendages in Fig. 11, *u.a.a.* is the upper, *lat. a a.* are the lateral ones, and *l.a.a.* are the inferior, or lower, ones. In Fig. 12 the

three lamellæ are marked *c.l.* When nearing maturity the sex of the Dragonfly-nymph may be distinguished in

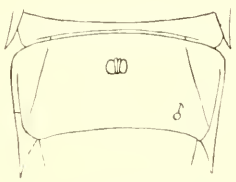


FIG. 17.—VENTRAL SURFACE OF NINTH SEGMENT OF NYMPH OF ANAX IMPERATOR (MALE).

(Much magnified.)

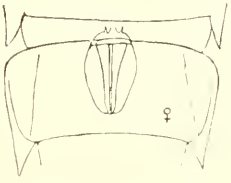


FIG. 18.—VENTRAL SURFACE OF NINTH SEGMENT OF NYMPH OF ANAX IMPERATOR (FEMALE).

(Much magnified.)

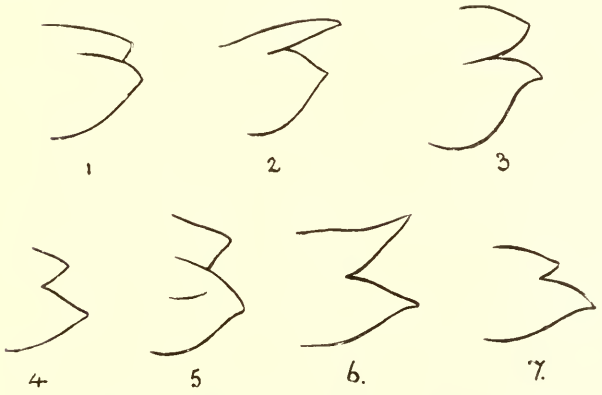


FIG. 19.—LEG-BASE PROCESSES OF VARIOUS ÆSCHNINE DRAGONFLIES.

1. ANAX IMPERATOR.
2. BRACHYTRON PRATENSE.
3. ÆSCHNA MIXTA.
4. ÆSCHNA JUNCEA.
5. ÆSCHNA CYANEA.
6. ÆSCHNA GRANDIS.
7. ÆSCHNA ISOSCELES.

(3, 4, 7, after Cabot.)

some species at least. It lies in the difference between a pair of valves on the underside of segment 9 (Figs. 17 and 18), and in the presence, in the males

of certain species, of a projection at the base of the upper anal appendage (Fig. 11, *m.p.*). A useful though rather obscure point which assists in distinguishing the species of the *Æschninæ*, is to be found in the relative size of, and the angle between, a pair of processes at the base of the forelegs. In Fig. 19 those of seven species are given. Though many of the nymphs at first sight appear to be smooth, a closer examination reveals the fact that they are all more or less covered with points or hairs. In some of the *Libellulinæ* the hairs are long and numerous. *Libellula depressa* is a good example of a hairy nymph, while *Anax imperator* is a comparatively smooth one.

TENTATIVE TABLES OF THE NYMPHS OF BRITISH ODONATA.

Any attempt to give a satisfactory statement of the points of differentiation of the nymphs of even the British *Odonata* cannot, with our present knowledge of them, be very satisfactory. The families and sub-families are fairly distinct, except in the case of the *Libellulinæ* and *Corduliinæ*; but it has been found quite hopeless to satisfactorily tabulate the genera, and this has not been attempted. The species, however, have been diagnosed as far as circumstances would allow.

I.—Table of Families.

Body robust; abdomen widest near the centre, and ending posteriorly in five caudal appendages; breathing by rectal branchiæ. [*Anisopterides*].

a. Abdomen somewhat flattened and much expanded at centre; mask spoon-shaped; eyes small, sub-conic, projecting; legs longer than abdomen — LIBELLULIDÆ.

b. Abdomen much more elongate; mask flattened (except *Cordulegaster*); eyes larger, rounded, conspicuous; legs shorter than abdomen ÆSCHNIDÆ.

Body long and slender; abdomen gradually tapering posteriorly, and ending in three caudal appendages. [*Zygopterides.*].. AGRIONIDÆ.

II.—Table of Sub-Families.

[Family LIBELLULIDÆ.]

Head squarish; antennæ seven-jointed; abdomen sometimes not truncate posteriorly; mid-dorsal line sometimes but slightly hooked .. LIBELLULINÆ.

Head pentagonal; abdomen truncate posteriorly; mid-dorsal line strongly hooked; antennæ seven-jointed, long CORDULIINÆ.

[Family ÆSCHNIDÆ.]

Antennæ four-jointed and flattened; fore- and mid-legs with tarsus two-jointed GOMPHINÆ.

Antennæ filiform and seven-jointed; all legs with tarsus three-jointed.

a. Mask spoon-shaped CORDULEGASTERINÆ.

b. Mask flattened ÆSCHNINÆ.

[Family AGRIONIDÆ.]

Antennæ with basal joint very long; legs of inordinate length; middle caudal appendage lamellar and short, outer ones three-edged; mask bilobed CALOPTERYGINÆ.

Antennæ with joints not conspicuously unequal; legs of moderate length; all caudal appendages lamellar and equal; mask flat and somewhat triangular AGRIONINÆ.

III.—Table of Species.

LIBELLULIDÆ.

A. Abdomen without lateral spines, or nearly so; body hairy.

I. Abdomen broad, obscurely mottled.

a. Very hairy; legs short; head narrow; eyes pointing backwards diagonally;

mid-dorsal hairy tubercles on segments 4 to 8, those on the hinder of those segments being smaller *depressa.*

b. Less hairy; legs not quite so stout; head broader, somewhat circular; eyes transverse; sharp dorsal spines on segments 4 to 8, not hairy *quadrimaculata.*

II. Abdomen more slender, distinctly spotted.. *cancellatum* (?).

B. Abdomen with lateral spines; body not hairy.

I. Abdomen without dorsal spines.

a. Abdomen beneath with three longitudinal black bands separated by white ones, upper surface ornamented with white dots; spines on segments 8 and 9 *dubia.*

b. Abdomen unornamented; spines on segments 8 and 9 short; head hollowed, size larger *striolatum* (?).

II. Abdomen with dorsal spines.

a. Abdomen unornamented; dorsal spines on 6 and 7 and lateral ones on 8 and 9 small; head arched; size smaller .. *scoticum.*

b. Lateral spines on segment 8 long, on 9 very long; head flat; eyes large; tibiæ naked, size larger *sanguineum* (?).

c. Abdomen posteriorly truncate; lateral spines on segments 8 and 9 very small; tibiæ hairy; antennæ conspicuous, basal joints stout; head pentagonal.

1. Head and eyes small; dorsal hook present on segment 9; lateral margins of same segment hairy *metallica.*

2. Head and eyes larger; dorsal hook absent, or nearly so, on segment 9; lateral margin of same segment entire *ænea.*

ÆSCHNIDÆ.

A. Antennæ four-jointed, flattened; fore- and mid-legs with tarsi two-jointed; mask not covering mouth, flat; legs strong, formed for burrowing; abdomen lanceolate, flat .. *vulgatissimus.*

B. Antennæ seven-jointed; all legs with tarsi three-jointed; mask covering mouth; legs formed for running; abdomen rounded above.

I. Mask spoon-shaped; abdomen not greatly lengthened nor much tapering towards base, hairy *annulatus.*

II. Mask flat; abdomen much elongated, tapering considerably towards base

a. Eyes large, in middle of side of head, which is flat; mask extending beyond mid-legs; lateral spines on segments 7 to 9; leg-base processes broad at tip, enclosing a right angle (Fig. 19) *imperator.*

b. Eyes rounded, at fore corners of head; mask extending to mid-legs; lateral spines on segments 6 to 9.

1. Leg-base processes equal, blunt, stout, not much separated, anterior narrower *mixta.*
2. Leg-base processes equal, sharp, long, bent outwards a little, the anterior one rather slender *grandis.*
3. Leg-base processes equal, short, enclosing a right angle, anterior smaller *cyanea.*
4. Leg-base processes much smaller than in *cyanea* (which species the nymph resembles); anterior half length of posterior; body looked at from side much flatter than *cyanea*. *juncea.*
5. Leg-base processes triangular, sharp, enclosing an acute angle, anterior half length of posterior *isosceles.*

c. Eyes small at fore corners of head, projecting in a bead-like manner; mask, extending about to mid-legs; lateral spines on segments 6 to 9 small; body slender; sides of head sloping much backwards; leg-base processes slightly separated, sharp, anterior about twice as long and half as wide as posterior *pratense.*

AGRIONIDÆ.

A. Middle caudal appendage lamellar, laterals three-edged.

I. A raised plate on fore part of head bearing the ocelli; caudal appendages perhaps proportionally shorter and more slender than in *C. splendens* *virgo.*

II. More highly developed caudal appendages; head somewhat pointed in front.. .. *splendens.*

B. All caudal appendages lamellar, traversed by much-branched tracheæ.

I. Lamellæ rounded at tip, spotted and banded; antennæ six-jointed *naias.*

II. Lamellæ pointed at tip; antennæ usually seven-jointed.

a. Lamellæ coloured.

1. Lamellæ mottled with brown; body comparatively short and stout *nymphula.*
2. Lamellæ spotted, long; eyes large *pennipes.*

b. Lamellæ hyaline, or nearly so, except the tracheæ.

1. Lamellæ with one margin only hairy *pumilio.*
2. Lamellæ with both margins hairy.

i. Several segments of abdomen marked dorsally with four dark, curved, longitudinal lines *elegans.*

ii. Abdomen with a darker longitudinal streak, thickest at the base of the segments on each side of medio-dorsal paler line *puella.*

iii. Dorsal surface of abdomen with a central dark patch on each segment (except 10), containing a pale, pear-shaped or triangular one; lamellæ rather broad, pointed, a thin black line across the middle *cyathigerum.*

CHAPTER V.

THE IMAGO.

So great is the general likeness amongst the imagines of the Dragonflies, that no difficulty need be experienced in recognising the oneness of the group even by the merest tyro. The head, though varying greatly in details, is always large and concave behind. The thorax tapers anteriorly and enters the hollow, where it is lightly attached to the head—so slight indeed is the attachment of the latter that its capability of rotation and movement is very great; in fact, although recognising the impossibility one cannot help conceiving the idea that the head is simply balanced on the projecting point of the thorax and not attached at all. The thorax has the three usual divisions, though the meso- and meta-thorax are modified in rather an unusual manner: as appendages it possesses six legs and four wings. There are ten segments to the abdomen, and also a small eleventh one in the female (very rudimentary in the male), and attached to the posterior part of the body are two or more anal appendages.

Eyes of large size and wonderful brilliancy are the most striking features of a Dragonfly's head. In one division

—the *Anisopterides*—they are contiguous (not, however in the *Gomphinæ*) to a greater or less extent along the middle line of the head, but in the other division—the *Zygopterides*—in which the head is transversely broad, or hammer-shaped, they are separated to a considerable degree. The number of hexagonal facets is very large, and in many cases the upper facets are of a greater size than the lower ones, this difference in size being probably co-ordinate with a difference in function. It has been suggested that the lower facets are suited for seeing objects near at hand, while the upper ones are used when the insect is on the look out for foes or food. Dragonflies possess also three *ocelli*, or *stemmata* (*i.e.*, rounded simple eyes). In the *Zygopterides* they are placed in a triangle on the top of the head between the compound eyes ; but in those species in which the latter occupy too much space there is a prominence in front of the line of contact, and two of the ocelli are placed on this, one on each side, while the third is in front and sometimes much hidden by the prominence.

The larger, swiftly-flying Dragonflies are able to see to a considerable distance, as witness the ease with which they sight one of their fellows, or some other insect, some dozen yards away, that appears fit to eat. Their sight, however, does not seem to be very perfect, for they often approach very close to another Dragonfly before discovering that it is of a different species, and not seldom turn away from an insect when quite close upon it, having discovered probably that it is not suitable for food or too dangerous to attack. They are readily startled by a shadow falling upon them, and by one's rapid approach, but they do not seem to notice

a gradual one. It is very difficult to approach one settled on the bare ground. *Æschna juncea* and other species sometimes have a proclivity, especially on warm autumn afternoons, for settling on the trunks of the pine trees that fringe a certain pond in Surrey. While so resting they are easily frightened when approached from the front, but if the approach is made from behind the tree a stroke may be made without frightening the insect, the handle of the net being dispensed with.

Dragonflies possess short, hair-like, inconspicuous antennæ, consisting of two stouter basal joints with four or five more slender distal ones.

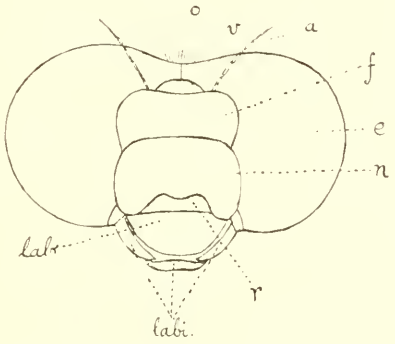


FIG. 20.—HEAD OF ÆSCHNA CYANEA.

o., Occiput; *v.*, Vertex; *a.*, Antenna; *f.*, Frons; *n.*, Nasus; *r.*, Rhinarium; *e.*, Eye *labr.*, Labrum; *labi.*, Labium.

Fig. 20 gives in outline the arrangement of the parts of the head of one of the larger Dragonflies—*Æschna cyanea*. That part of the head in which the ocelli are situated is called the *vertex*, which extends back as far

as the insertion of the antennæ. Behind this and, consequently, in those genera in which the eyes meet, to the rear of their point of junction, is the *occipital region.* Anterior to the vertex is the *frons*, in front of which is the *post-clypeus*, or *nasus*, and in front of that again the *ante-clypeus*, or *rhinarium*. On each side, between the eye and the mouth, is the *gena*, while the *gula* forms the base of the head, and is bounded anteriorly by the *mentum*, or chin, which is situated at the base of the labium. (See also Figs. 23 and 24.)

The lower part of the face is occupied by the mouth, the arrangement of which is of special importance, seeing that we are dealing with a carnivorous insect. It is closed above by the *labrum*, or upper lip, and below by the *labium*, or lower lip. This latter is composed of three pieces, the median lobe and two lateral ones. The

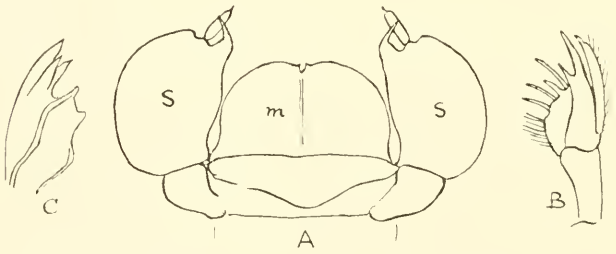


FIG. 21.—MOUTH-PARTS OF ÆSCHNA CYANEA.

A, Labium: *s.*, Side Lobes; *m.*, Median Lobe. B, Maxilla. C, Mandible.

former is cleft in the centre in the *Agrionidæ*, the *Cordulegasterinæ*, and some *Gomphinæ*. In the rest it is entire, although in the *Æschninæ* a line indicates the fissure found in the other groups (Fig. 21, A). These

parts, the labrum and the labium, move vertically Between them on each side are two pieces, the *mandibles* (Fig. 21, C) above and the *maxillæ* below (Fig. 21, B), which move horizontally. The mandibles, which are armed with jagged tooth-like indentations, are the parts chiefly concerned in crushing the food. By some, and probably correctly, the side pieces of the labium (Fig. 21, A, s) are looked upon as a second pair of maxillæ, but we are only concerned with their function, that they act as parts of the lower lip. In the interior of the mouth, attached to the labium, is the *lingua*, or tongue. When fully open, the orifice of the mouth is very large, an obvious advantage to an insect that catches its prey upon the wing.

Behind the head, and in some species quite hidden within the cavity mentioned above, is the prothorax (Fig. 22, A and D). The pro-sternum, or ventral surface of it, is small, but bears the fore-legs; the pro-notum, or dorsal surface, somewhat larger, is in the *Agrionina* sometimes sufficiently varied to assist in differentiating the species. The meso-thorax always greatly overlaps the meta-thorax—so much so that the meso-notum and meta-notum are pushed quite back, and the attachments of both pairs of wings are behind those of the mid- and hind-legs. Especially is this the case in the *Zygopterides*.

Three tarsal joints are found in the legs of all British Dragonflies, the basal one being invariably the smallest (Fig. 22, C). The most noticeable point in connection with the legs is the double series of long bristles which adorn them, and which seem to perform a very important duty. It will quickly be noticed that a

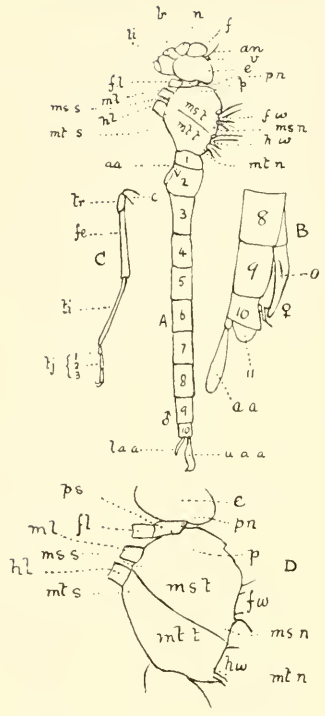


FIG. 22.—LATERAL VIEW OF IMAGO.

A: *li.*, Labium; *lr.*, Labrum; *n.*, Nasus; *f.*, Frons; *an.*, Antenna; *v.*, Vertex; *e.*, Eye; *p.*, Prothorax; *p.n.*, Pro-notum; *ms.t.*, Meso-thorax; *ms.n.*, Meso-notum; *ms.s.*, Meso-sternum; *mt.t.*, Meta-thorax; *mt.n.*, Meta-notum; *mt.s.*, Meta-sternum; *f.l.*, Fore-leg; *m.l.*, Mid-leg; *h.l.*, Hind-leg; *f.w.*, Fore-wing; *h.w.*, Hind-wing; *au.*, auricle; 1-10, Segments of Abdomen; *u.a.a.*, Upper Anal Appendages: *l.a.a.*, Lower Anal Appendage.

B: 8-11, Distal Segments of Abdomen of Female; *a.a.*, Anal Appendages; *o.*, Ovipositor.

C: *c.*, Coxa; *tr.*, Trochanter; *fe.*, Femur; *ti.*, Tibia; *t.j.*, Tarsal Joints.

D: References same as in A, except *.s.*, ro-sternum.

Dragonfly's legs do not appear suited for walking, and that in fact it does not much use them for that purpose. It will be further noticed that when projected forward they all meet at about the same level in front of the mouth. Now, there is very little doubt, though on account of the rapid flight it is impossible to observe the fact, that the Dragonfly, with the assistance of the rows of bristles, makes a trap of its legs in which to catch its prey upon the wing, and that the prey so caught is by the length of the legs brought readily in front of the mouth, which by its great expansibility is opened to receive it. This is certainly what occurs when an insect is offered to a Dragonfly held captive in the hand by the wings. (See page 7).

Though possessing considerable differences there is a great general resemblance between the wings of Dragonflies. The main nervures all have a sub-parallel direction, and these are joined by a large number of small transverse nervures, producing an intricate meshwork of cells. In one division, the *Anisopterides*, forming the families *Libellulidæ* and *Æschnidæ*, the hind-wings are larger and different in shape from the fore-wings. In the other division, the *Zygopterides*, forming the family *Agrionidæ*, the wings are similar and nearly equal. The shape, size, and colour of the pterostigma and accessory membrane, the conformation of the triangle, the number of ante-cubital nervures, and the colour of the costa, are important points in classifying the genera and species.

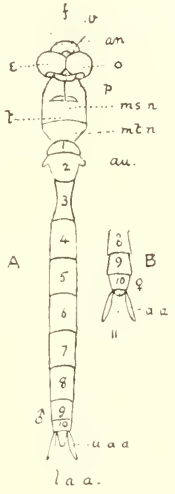


FIG. 23.—DORSAL VIEW OF IMAGO.

A: *e.*, Eye; *f.*, Frons; *v.*, Vertex; *an.*, Antenna; *o.*, Occiput; *p.*, Prothorax; *t.*, Thorax; *ms.n.*, Meso-notum; *mt.n.*, Meta-notum; *au.*, Auricle; 1-10, Segments of Abdomen; *u.a.a.*, Upper Anal Appendages; *l.a.a.*, Lower Anal Appendage.

B: 8-11, Distal Segments of Abdomen of Female; *a.a.*, Anal Appendages.

On reference to Fig. 24, A, B, and C, it will be noticed that five longitudinal nervures terminate at the base of the wing; these are, starting at the front margin, the costa, sub-costa, median, sub-median, and post-costa. The costa and median extend to the tip

of the wing, the former constituting the front margin, and being bent near the centre at the cubital point,

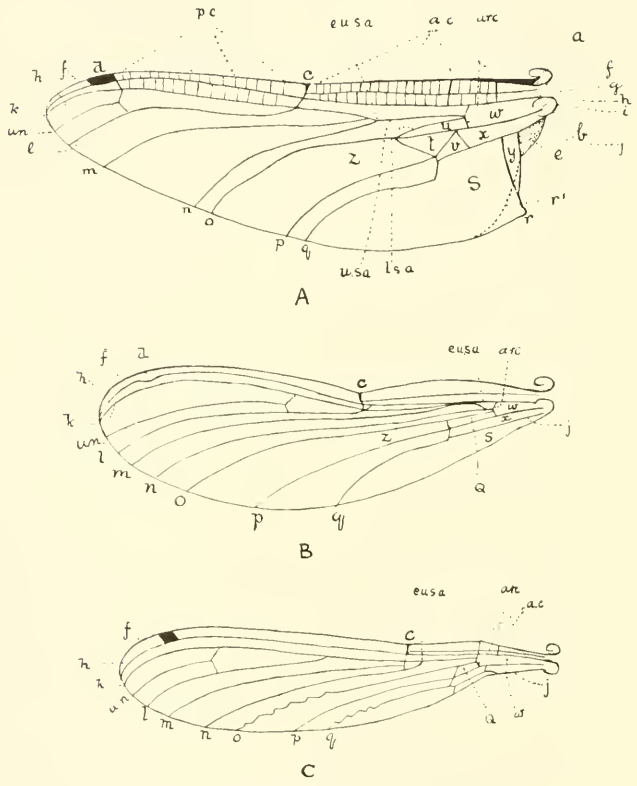


FIG. 24.—TYPICAL DRAGONFLY WINGS.

A: *a.*, Anterior Axillary Callus; *b.*, Posterior Axillary Callus; *c.*, Cubital Point; *d.*, Pterostigma; *e.*, Accessory Membrane (or Membranule); *f.*, Costa; *g.*, Sub-costa; *h.*, Median Nervure; *i.*, Sub-median Nervure; *j.*, Post-costa; *k.*, Principal Sector; *l.*, Nodal Sector; *m.*, Sub-nodal Sector; *n.*, Median Sector; *o.*, Short Sector; *p.*, Upper Sector of the Triangle; *q.*, Lower Sector of the Triangle; *r.*, Anal Angle (*r*¹. Anal Angle of Wing of Female); *s.*, Post-costal Space; *t.*, Triangle; *u.*, Supra-triangular Space; *v.*, Internal Triangle; *w.*, Basilar Space; *x.*, Median Space; *y.*, Anal Triangle (when present); *z.*, Post-trigonal Space; *arc.*, Arculus; *a.c.*, Ante-cubital Nervures; *p.c.*, Post-Cubital Nervures; *u.s.a.*, Upper Sector of Arculus; *l.s.a.*, Lower Sector of Arculus *e.u.s.a.*, End of Upper Sector of Arculus; *u.n.*, Ultra-nodal Sector.

B and C: References the same, except Q., the Quadrilateral.

where there is a thick cross-vein—the node. At the node the sub-costa terminates. Near the base of the wing a bent cross nervure joins the median and sub-median: this important little nervure is called the arculus, and from the centre of its distal side start the upper and lower sectors of the arculus. The upper sector after proceeding for a short distance divides into the principal sector above and the median sector below (nothing to do with the median nervure). Between these two are the nodal sector, branching from the principal at or near the node, and the sub-nodal, leaving the principal near its basal extremity. The lower sector of the arculus bends down till it meets the sub-median nervure at the termination of the latter, from which point starts the short sector. Between the sub-median and the post-costa are three spaces—*r.*, *r.*, and *t.* of Fig. 24, A; the distal one, *t.*, is the triangle. From its apex, where the sub-costa terminates, start two sectors—the upper and lower sectors of the triangle. The ultra-nodal sector is found between the principal and sub-nodal.

Such is a general description of an Anisopterid wing; that of a Zygopterid is fundamentally very similar, only that the triangle and supra-triangle (*t.* and *u.* of Fig. 24, A) are united to form the quadrilateral, Q, of Fig. 24, B and C.* In the British *Calopterygina* the principal sector is for a time near its basal end in contact with the median nervure, which it shortly leaves again. A lens of a very low power will, however, reveal the two lying side by side. Individuals may perhaps be found in which they do not quite touch.

* Some say that *u* alone corre-ponds to the quadrilateral.

When everything is still around, the wings of the larger species may be heard beating at several yards distance. So skilful is a Dragonfly in the use of its wings that it is often impossible to see how it turns in its flight, and it has been stated that it is even able to fly backward, an operation which the author has not been able to verify.

Ten segments, of which the basal one near the thorax is reckoned the first, form the abdomen (Figs. 22 and 23). Their shapes and relative sizes will be best seen from the illustrations of the various species, and it will be found that the variation is by no means limited. On the ventral surface of the second segment of the male are some accessory reproductive organs, from a receptacle in which the eggs are immediately fertilised. The sexual organs proper of male, and ovipositor (when present) of female, are found on the ventral side of the ninth segment. Attached to the tip of the abdomen of the male are two superior appendages, and one inferior in the *Anisopterides* (two inferior ones in the *Zygopterides*). The inferior appendages belong to the anal, or eleventh segment, the superiors to the tenth. In the female there are two superior appendages only, both attached to the tenth segment. These appendages, which in the male vary greatly, are important for classificatory purposes.

Breathing is carried on by ten pairs of spiracles, one pair on the meso-thorax, another on the meta-thorax, and the remaining eight pairs on the abdomen. As the insect breathes its abdomen rhythmically expands and contracts laterally, not longitudinally, that is, it does not alter in length, but in breadth.

For descriptive purposes the junction of the thorax and abdomen is looked upon as the centre of an insect, and that extremity of every part or appendage nearest to the centre is spoken of as basal, the opposite extremity being known as distal or apical. The terms anterior or fore, and posterior or hind, have reference to position near or remote, respectively, from the front of the head. Longitudinal refers to anything lying in the length of the insect—along or parallel to its main axis; transverse means across the body from side to side. That is the right side of an insect which is on the right-hand side to a person looking along the insect from the rear to the head, as it lies on its ventral surface.

ANALYTICAL TABLES.

For purposes of classification chiefly, the following tables have been drawn up. They generally refer to very prominent features, and must be applied with caution to any but the British Dragonfly Fauna. To identify an insect it must first be referred to its proper family, then sub-family, genus, and species. Deviation from this order may lead to confusion.

I.—Table of Families.

A. Wings dissimilar, hind-wings usually broader at base, kept spread out flat in repose; an accessory membrane present; males with one inferior anal appendage; eyes meeting on top of head (except *Gomphus*). [ANISOPTERIDES.]

a. Abdomen with lateral carinæ; females without ovipositor; triangle of fore-wings with its long axis transverse, of the hind-wings longitudinal LIBELLULIDÆ.

b. Triangle of fore- and hind-wings similar, long axis longitudinal; males usually with two auricles on segment 2, and the inner margin of hind-wings hollowed .. ÆSCHNIDÆ.

B. Front- and hind-wings similar in shape, closed vertically in repose (except *Lestes*, which keeps them partly open); no accessory membrane; males with two inferior anal appendages [ZYGOPTERIDES] AGRIONIDÆ.

II.—Table of Sub-Families.

[Family LIBELLULIDÆ.]

A. Males without auricles on segment 2, and inner margin of hind-wings not hollowed; abdomen never bronze; anal appendages of male simple; of female short, cylindrical, or spindle-shaped .. LIBELLULINÆ.

B. Males with auricles on segment 2, and inner margin of hind-wings hollowed; abdomen bronze-green; anal appendages of male elaborate; of female leaf-like CORDULIINÆ.

[Family ÆSCHNIDÆ.]

A. Eyes separated from one another; abdomen without lateral carinæ; females without ovipositor.. GOMPHINÆ.

B. Eyes just meeting at a point; abdomen without lateral carinæ; ovipositor present in female CORDULEGASTERINÆ.

C. Eyes in contact on top of head for a greater or less distance; abdomen with lateral carinæ; ovipositor present in female.. ÆSCHNINÆ.

[Family AGRIONIDÆ.]

A. Many ante-cubital nervures; wings coloured; female with white pterostigma; male with none CALOPTERYGINÆ.

B. Two ante-cubital nervures; wings stalked and uncoloured; pterostigma present in both sexes and coloured AGRIONINÆ.

III.—Table of Genera.

[Sub-Family LIBELLULINÆ.]

A. Triangular dark spot at base of hind-wings.

a. Abdomen mid-dorsally spotted, sides parallel **Leucorrhinia.**

b. Abdomen without mid-dorsal spots, sides not parallel **Libellula.**

B. Wings unspotted.

a. About seven ante-cubital nervures; adult male red or black **Sympetrum.**

b. About twelve ante-cubital nervures; adult male with abdomen blue **Orthetrum.**

[Sub-Family CORDULIINÆ.]

A. Abdomen without mid-dorsal spots.

a. Inferior anal appendage of male triangular **Somatochlora.**

b. Inferior anal appendage of male deeply cleft **Cordulia.**

B. Abdomen spotted mid-dorsally with yellow; inferior anal appendage of male notched only at hinder extremity; superiors with a long basal internal point **Oxygastra.**

[Sub-Families GOMPHINÆ and CORDULEGASTERINÆ.]

Each sub-family contains but one genus, and each genus but one species, the ground-colour in each case being black.

a. Size moderate; yellow marks longitudinal **Gomphus.**

b. Size large; yellow marks transverse **Cordulegaster.**

[Sub-Family ÆSCHNINÆ.]

A. Abdomen unspotted, but with a black, mid-dorsal jagged line on blue or green ground; anal angle of hind-wings of male rounded; auricles absent; pterostigma narrowish .. **Anax.**

B. Abdomen spotted.

a. Pterostigma very narrow indeed; anal angle of hind-wing of male very bluntly pointed; inferior anal appendage of male lightly notched at tip **Brachytron.**

b. Pterostigma not very narrow; anal angle of hind-wing of male distinctly pointed; lower anal appendage of male pointed .. **Æschna.**

[Sub-Family CALOPTERYGINÆ.]

Characters of sub-family **Calopteryx.**

[Sub-Family AGRIONINÆ.]

A. Abdomen with segments 1, 2, 9, 10 blue in male; whole abdomen bronze-green in female

a. Eyes blue; rest of abdomen of male green **Lestes.**

b. Eyes red; rest of abdomen of male steel-black **Erythromma.**

B. Abdomen crimson, with bronze markings .. **Pyrrhosoma.**

C. Abdomen black; segments 8 or 9 blue in male; a circular blue spot behind eyes; small apical ventral spine on 8 in female; pterostigma of male darker on fore-wings than on hind; nodal sector arising at fourth post-cubital on fore-wings, third on hind-wings **Ischnura.**

D. Abdomen of male blue, marked with black.

a. Mid and hind tibiæ dilated, whitish, margins with long black spines **Platychnemis.**

b. Tibiæ not dilated; a pear-shaped blue spot behind eyes.

1. No apical ventral spine on 8 in female; pterostigma similar on fore- and hind-wings; nodal sector as in *Enallagma* (except *mercuriale*) **Agrion.**

2. Distinct apical ventral spine on 8 in female; pterostigma similar on fore- and hind-wings; nodal sector arising near fifth post-cubital on fore-wings, fourth on hind-wings (or more remote) . **Enallagma.**

IV.—Table of Species.

Leucorrhinia, Cordulia, Oxygastra, Gomphus, Cordulegaster, Anax, Brachytron, Platychnemis, and **Erythromma,** containing each but one species, the characters of the genus will determine the species.

[Genus **Sympetrum**.]

A. Legs yellowish.

a. Dorsal surface of abdomen of male vermilion, often not well developed, with yellow spots near the hinder margin of segments; female brown; largest species *striolatum*.

b. Dorsal surface of abdomen of male bright crimson; nervures of wings crimson in both sexes *fonscolombii*.

c. Dorsal surface of abdomen of male dull red; basal third of wing (more or less) deep saffron in both sexes *flaveolum*.

B. Legs black; abdomen dilated towards extremity.

a. Abdomen of male crimson *sanguineum*.

b. Adult male almost entirely black; a yellow fleur-de-lys on ventral surface of metathorax in both sexes *scoticum*.

[Genus **Libellula**.]

A. Wings without black spots at node; abdomen of adult male blue.

a. An oblong dark patch at base of fore-wings, and a triangular one at base of hind-wings *depressa*.

b. Two dark lines at base of fore-wings, and a dark line and smaller triangle at base of hind-wings *fulva*.

B. Wings with a black spot at the node *quadrimaculata*.

[Genus **Orthetrum**.]

A. Smaller species; pterostigma yellow; wings of female often yellow towards costa; abdomen of male all blue *cærulescens*.

B. Larger species; pterostigma black; wings hyaline; last four segments of abdomen of male more or less black *cancellatum*.

[Genus **Somatochlora**.]

A. Superior anal appendages of male not angled at middle, with two teeth below (Fig. 27). *metallica*.

B. Superior anal appendages of male angled at middle like forceps of some earwigs, three or four teeth below (Fig. 28). *arctica.*

[Genus **Æschna**.]

A. Abdomen nearly black, spotted with blue (generally yellowish in female); wings hyaline.

a. Eyes meeting but for a short space; spots all blue, nearly obliterating ground-colour. *cærulea.*

b. Eyes in contact for a long distance.

1. Dorsal blue spots on segments 9 and 10, divided in middle.

(i.) Costa brown; suture between nasus and frons without black line *mixta.*

(ii.) Costa golden; suture between nasus and frons distinctly black *juncea.*

2. Dorsal blue spots on segments 9 and 10 united; two *large* oval yellowish-green spots on front of thorax *cyanea.*

B. Abdomen russet, but little spotted; wings brown.

a. Accessory membrane small, pale; without mid-dorsal triangle on segment 2 *grandis.*

b. Accessory membrane large, black; a bright yellow triangle on segment 2 *isosceles.*

[Genus **Calopteryx**.]

A. Wings of male almost entirely blue; of female brown; pterostigma rather distant from tip of wing *virgo.*

B. Wings of male with a large blue patch only in centre; of female greenish, pterostigma nearer tip of wing *splendens.*

[Genus **Lestes**.]

A. Shorter and stouter species; wings larger; anal appendages of males (Fig. 38); black spot on dorsal surface of first segment of female rectangular (Fig. 40, *a.*) *dryas.*

B. More slender species; wings smaller; anal appendages of male (Fig. 39); black spot on dorsal surface of first segment of female semi-elliptical (Fig. 40, *b*.) *sponsa*.

[Genus **Pyrrhosoma**.]

A. Species large and bulky; front of thorax with two crimson stripes; abdomen of male partly bronze *nymphula*.

B. Species smaller and more slender; front of thorax without lines (or extremely fine yellow ones); abdomen of male entirely crimson; abdomen of female crimson on the first, second, and third segments only.. *tenellum*.

[Genus **Ischnura**.]

A. Species small; black, with ninth and part of eighth segments blue in male, not in female; hind lobe of prothorax rounded, raised .. *pumilio*.

B. Larger species; black, with eighth segment entirely blue (ninth black) in both sexes; hind lobe of prothorax narrow, much raised *elegans*.

[Genus **Agrion**.]

A. Male with a U-shaped black mark on dorsal surface of second segment of abdomen, mark joined to the black circlet behind; female blue and black, resembling male.. *pulchellum*.

B. Male with a U-shaped black mark on second segment, *not* attached to the circlet; female abdomen black-bronze, except yellowish circlets *puella*.

C. Male with black Mercury sign (Plate XXVI., *a*.) —a circle with two horns in front and a stem behind joining it to circlet—on second segment; female abdomen black-bronze, with two blue circlets near extremity .. *mercuriale*.

[Genus **Enallagma**.]

A. Male with a black ellipse, generally joined to the circlet on the second segment; female abdomen green or blue, with a large conical black spot on most segments, but leaving a fair amount of ground-colour between .. *cyathigerum*.

Months in which Imago is on the Wing.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Leucorrhinia dubia					*	*	*					
Sympetrum striolatum ..						*	*	*	*	*	*	
,, *fonscolombii* ..						*						
,, *flaveolum* ..								*	*			
,, *sanguineum* ..							*	*	*	*		
,, *scoticum* ..						*	*	*	*	*		
Libellula depressa				*	*	*	*	*				
,, *quadrimaculata*				*	*	*	*	*	*?			
,, *fulva*						*		*				
Orthetrum cærulescens ..						*	*	*	*			
,, *cancellatum* ..					*	*	*					
Somatochlora metallica ..							*	*				
,, *arctica* ..						*						
Cordulia ænea					*	*	*?		*?			
Oxygastra curtisii							*					
Gomphus vulgatissimus ..					*	*						
Cordulegaster annulatus						*	*	*				
Anax imperator					*	*	*	*				
Brachytron pratense ..				*	*	*	*					
Æschna mixta								*	*		*	
,, *cærulea*						*						
,, *juncea*						*	*	*	*			
,, *cyanea*							*	*	*	*		
,, *grandis*						*?	*	*	*			
,, *isosceles*					*	*						
Calopteryx virgo					*	*	*	*				
,, *splendens* ..					*	*	*	*				
Lestes dryas						*	*	*				
,, *sponsa*						*	*	*	*			
Platychnemis pennipes ..						*	*	*				
Erythromma naias					*	*	*					
Pyrrhosoma nymphula ..				*	*	*	*	*				
,, *tenellum* ..						*	*	*	*			
Ischnura pumilio						*	*	*	*			
,, *elegans*					*	*	*	*	*			
Agrion pulchellum					*	*	*					
,, *puella*					*	*	*	*				
,, *mercuriale*						*	*	*				
Enallagma cyathigerum ..				*	*	*	*	*	*			

From Longfield's "Dragonflies": 1st Appearances:

Last week April/1st week May:

Pyrrhosoma nymphula,	Large Damsel-fly. -4/8 Loc. common.
Brachytron pratense,	Hairy Dragon-fly. - 2/7. F.c. Local. Hants. I.W.

2nd & 3rd weeks May:

Cordulia aenea,	Downy Emerald. - 1/8. Locally c. H, S.
Ischnura elegans,	Common Ischnura. -3/4 C. in S. Engd
Enallagna cyathigerum,	Common Blue Damsel-fly - 4/9 C.
(Coen)agrion puella,	Common Coenagrion - 2/8. C.
Do. armatum,	Norfolk Coenagrion. -2/6 V.R. "
Do. pulchellum,	Variable Coenagrion. -4/7 V.L. H. I.W. S[x]
Gomphus vulgatissimus,	Club-tail Dragon-fly. -7/7 Sc. Sus[x] Dorset
Libellula depressa,	Broad bodied Libellula. -3/8 V.C.
Do. quadrimaculata,	4-spotted Libellula. -3/8 V.C. locally.

Last week May/1st week June:

Agrion virgo. (Calopteryx)	Demoiselle Agrion. -4/8. V.C.
Do. splendens,	Banded Agrion. - 2/8. C. in S. Engl[d]
Ischnura pumilio.	Scarce Ischnura. - 4/7 V.R. H (C. in one area)
Erythromma najas,	Red-eyed Damsel-fly. -1/8 R. H.
Orthetrum cancellatum,	Black lined Orthetrum. -1/8 V. local - H. S[x]
Libellula fulva	Scarce Libellula. -4/7 R. S[x]
Coenagrion mercuriale,	Southern Coenagrion. -4/8 R. H (not uncom)
Ceriagrion tenellum,	Small red Damsel-fly. -1/9 R.L. H-S[x]
Anax imperator,	Emperor Dragon-fly. -4/9 Not. c. Hants, I.W. Sus[x]
Platycnemis pennipes,	White-legged Damsel-fly. Not uncom. S. Eng[d] H -4/8. [over running H2O]

2nd & 3rd weeks June:

Oxygastra curtisii,	Orange-spotted Emerald.
Orthetrum coerulescens,	Keeled Orthetrum. -2/8. SPHAGNUM BOGS - H - RARE.
Cordulegaster beltonii,	Golden-ringed Dragon-f. UNC - LOCAL - DORSET, I.W. Sus? -1/10
Aeschnea coerulea,	Blue Aeschna. -2/8. ONLY SCOTLAND.
Co. isosceles,	Norfolk Aeschna. -2/8. " ONLY.
Somatochlora metallica,	Brilliant Emerald. -2/9 V. LOCAL - H, S?
Do. arctica.	Northern Emerald. -4/7 ONLY 1 LOCALITY H, + 1 DEVON
Leucorrhinia dubia,	White-faced Dragon-fly. V.R. N.ENGL? -3/8
Coenagrion hastulatum,	Northern Coenagrion.

Last week June/1st week July:

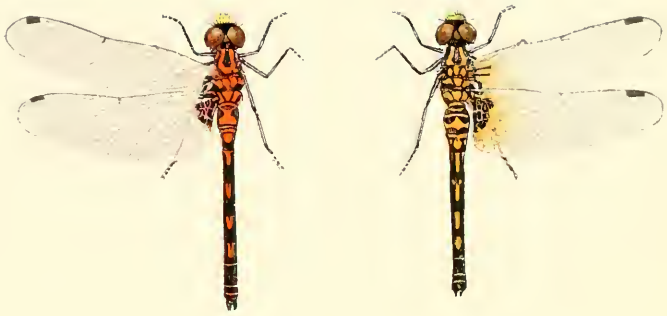
Aeschnea cyanea,	Southern Aeschna. -1/9. V.C.
Lestes sponsa,	Green Lestes. -2/8. LOCAL. NOT UNCOM. H
Do. dryas,	Scarce Green Lestes. -2/8 R. S?
Sympetrum striolatum.	Common Sympetrum. V.C.
Do. fonscolombii,	Red-veined do. -/8. R. SE. V. INTERMIT IMMIGRANT. H
Do. flaveolum.	Yellow-winged do. -3/9 IMM. (LESS R THAN ABOVE) H.

2nd & 3rd weeks July:

Aeschna grandis,	Brown Aeschna. - 1/10. V.C.
Do. juncea,	Common Aeschna. -4/9. V. " .
Sympetrum sanguineum,	Ruddy Sympetrum' -1/9 V-LOCAL. S?
Do. danae,	Black Sympetrum -3/10 V.LOCAL. H.

Last week July/1st wk. Aug.:

Aeschna mixta.	Scarce Aeschna. -4/10. S+E. HANTS. NOT UNCOM.



Leucorrhinia dubia
(nat. size).



Sympetrum striolatum
(nat. size).

CHAPTER VI.

GENERA AND SPECIES.

1. Leucorrhinia dubia, Lind.

(Plate I.).

Synonymy.

Libellula dubia, Lind. Mon. Lib. Eur. 16 (1825); Selys Rev. Odon. 50 (1850); Hag. Ent. Ann. 45 (1857). *Leucorrhinia dubia*, McLach. Cat. Brit. Neur. 11 (1870). *Leucorhinia dubia*, Kirby Syn. Cat. Neur. Odon. 12 (1890). *L. rubicunda*, Curtis Brit. Ent. xv., pl. 712 (1838); Selys Mon. Lib. Eur. 56 (1840). *Diplax rubicunda*, Evans Brit. Lib. 28, pl. 21, f. 3 (1845). *L. melanostigma*, Eversm. Bul. Mosc. 238 (1836).

Vander Linden's description.

Mas. Caput viride, margine postico, et macula triangulari ante oculos nigris. Oculi fusci, subtùs virescentes. Thorax nigro-æneus, suprà strigis duabus longitudinalibus interruptis, maculisque lateralibus, duabus majoribus, et quatuor aut quinque minoribus, flavis.

Scutellum flavum. Abdomen nigrum: primum segmentum margine postico; 2. fasciis duabus et macula utrinque; 3. 4. 5. 6. 7 macula dorsali, luteis. Appendices anales nigræ, superiores duobus ultimis segmentis abdominis conjunctis paulò breviores; inferior his dimidio brevior. Pedes nigri. Alæ albæ, callis luteis, macula marginali subquadrata fusca, membranula accessoria alba; anticæ puncto, posticæ puncto et macula triangulari baseos nigris. . . . Long. 13-14. lin. extens. alar. 26. lin. . . . Feminam non vidi. . . . Obs. Hæc species forsitan vera *L. rubicunda* Linnæi est, cujus descriptio illi satis convenit: sed nimia ejus brevitas judicium certum ferre non sinit (P. L. Vander Linden, "Monographiæ Libellulinarum Europæarum Specimen," 16, 1825.)

Size.

Length of Male, 35·5mm. to 39mm.; expanse of wings,* 53mm. to 58mm. Length of Female, 34mm. to 36mm.; expanse of wings, 52mm. to 55mm.

Male Imago.

Head. Face pale yellow, with black hairs; labrum narrowly edged with black; labium black; vertex black, preceded by a broad black line extending along the side of the eyes; *eyes* blackish-brown, ashy-green beneath. *Thorax* black, clothed with palish hairs; on the front of thorax two broad, longitudinal, crimson stripes, almost interrupted towards the posterior end; several other spots and lines on the sides; prominences between the wings crimson. *Wings* hyaline, a triangular dark brown spot

* "Expanse of wings" in all cases refers to hind-wings.

with pale nervures at the base of the hind-wings, and a short line of the same colour nearer the costal margin, a very small spot at the base of the fore-wings. *Pterostigma* nearly square, dark brown, 2mm. long. *Accessory membrane* small on fore-wings, long but narrow on hind-wings, and conspicuous against the dark spot. *Legs* black. *Abdomen* almost cylindrical, slender, swollen at the base, not much constricted at the third segment, rather downy, black, with crimson spots, the crimson markings being as follow: On segment 1, a tiny lateral spot and a line along the hind edge; 2, except at the base nearly all crimson; 3, a large basal spot, constricted at the middle and having two tiny dorsal black spots near the base; 6 and 7, a basal, dorsal, wedge-shaped spot; 7, 8, and 9, the hind margin crimson; sometimes 4, 5, and 8 have small dorsal spots or lines. *Anal appendages*, upper, black, cylindrical, pointed, as long as the ninth segment, rather distant at base; lower, short, squarish, indented behind, black.

Female Imago.

In general appearance the female does not greatly differ from the male. The *labrum* is black except at the corners. The spots are all pale yellow in place of crimson, and the dorsal ones on the abdomen are longer and more equal on the various segments, abdomen itself stouter and shorter than in male. *Basal spot* on wings larger and lines longer, the spot on the fore-wing being often produced as a line. *Pterostigma* 2·5mm. *Anal appendages* but little longer than the tenth segment, black, cylindrical, pointed. *Vulvar scale* consists of two small, thick, parallel projections.

Immature * Colour.

In the freshly disclosed male the markings are pale yellow as in the mature female.

Variation.

Sometimes the base of the wings is slightly tinted with saffron, but perhaps only in the female. Mr. J. Arkle, in June, 1897, took a specimen on Whitegate Heath, Delamere Forest, in which "all the wings were suffused with smoky saffron, the suffusion being strongest at the wing-bases and weakening gradually towards the margins." De Selys mentions specimens with suffused wings, though apparently not to such an extent as in Mr. Arkle's specimen. (De Selys, "Revue des Odonates," p. 52.)

Nymph.

Body of the usual sepia tint, broad and somewhat flattened; length, including appendages, 20mm., greatest breadth 6·5mm. *Head* rather small, somewhat triangular, width 5·5mm., narrow from front to back. *Antennæ* of seven joints, the basal two being short and rather swollen, the rest longer, more slender, and darker. *Mask* barely extending to the insertion of the mid-legs, narrow at hinge, spoon-shaped, covering the face; palpi broad where they approach, and there serrated; middle lobe of mask produced into a blunt point. *Eyes* as spherical, or rather conical, knobs, inserted rather far back, prominent, the axis oblique to the mid-line of the body. *Top of head* convex.

* Also called "Teneral."

Occiput hairy, hind margin straightish. *Prothorax* rather small, collar-like, edged behind with a ring of hairs. *Meso-thoracic* spiracles rather conspicuous, pointing somewhat backwards. *Legs* long; front ones 10·5mm., hind 16·5mm., rather faintly banded with two darker brown bands on femora; distal end of tibiæ and of third tarsal joint dark; tibiæ, especially fore and mid ones, hairy. *Wing-cases* about 5mm. long. *Abdomen* with a pale mid-dorsal line, somewhat raised at the posterior part of the segments; about 1·5mm. away on each side a line of dark brown suffused spots, preceded in each case by a white one; another row of white spots, less distinct, outside these; and on the lateral carinæ a whitish spot at the sutures between the segments. Segment 9 rather truncate behind, 10 small. Pronounced *lateral spines* on segments 8 and 9, especially on the latter. *Upper anal appendage* triangular, sharp, as long as segments 9 and 10, whitish mid-dorsally; *laterals* about half the length of upper, *lower* two about as long as upper, rather darker and narrower. *Under side of abdomen* with a mid-ventral and two lateral (one on each side) dark brown bands separated and bounded on the outside by four conspicuous pale ones. (From a nymph-skin obtained at Rannoch, in June, 1898, and given to the author by Mr. C. A. Briggs, who found it at a very small pool, thus proving that it breeds in pools. Perhaps it does not breed in the neighbouring lochan.)

Date.

This insect has been found on the wing from the end of May, in Yorkshire, till July or August in Inverness.

Habits.

Mr. J. Arkle, who has paid much attention to this species in Cheshire, says that it frequents heather-clad undulating ground, where pools and swamps occur, and that it flies low over the heather with a rapid flight of, as a rule, about a dozen yards at a time. The dodging, sparrow-like flight of the males is not easily forgotten. That of the females is similar in character, but they are not so difficult to net. The males have a fine appearance on the wing—dark blue and carmine—the blue appearance being due to the sun on the wings and to the underside of the abdomen.

Distribution.

In *L. dubia* we have a Northern species, found only in Scotland and the north of England. But few localities have, unfortunately, been recorded for this handsome Dragonfly. *Inverness-shire:* Glencannich, Strathglass, one (J. J. F. X. King); Aviemore, a few (K. J. Morton). *Perthshire:* Rannoch, fairly common (C. A. Briggs). *Westmoreland:* Witherslack, one (J. E. Fletcher). *Yorkshire:* Thorne Moor, near Doncaster* (G. T. Porritt). *Cheshire:* Delamere Forest district—Oakmere Moss and Abbot's Moss, very common (J. Arkle). *Staffordshire:* Cannock Chase, two (R. C. Bradley). *Lincolnshire:* J. C. Dale, *vide* E. M. M., vol. xx., 1884, p. 252). H. Doubleday said that it occurred, but always rarely, among old gravel-pits on Coopersale Common, Epping (E. M. M., vol. viii., 1871, p. 86).

* This locality was by mistake at one time recorded as Thorne Moor, near Dorchester, and the southern locality was cited by various authors. The error was pointed out by Mr. W. H. Bath in the *Entomologist* for 1893, p. 108.

2. Sympetrum striolatum, Charp.

(Plate I.).

Synonymy.

Libellula striolata, Charp. Lib. Eur. 78, t. 10., f. 2 (1840); Selys Rev. Odon. 40 (1850); Hag. Ent. Ann. 43 (1857). *Sympetrum striolatum*, McLach. Cat. Brit. Neur. 11 (1870). *L. vulgata*, Don. Brit. Ins. x., t. 337. f. 1 (1801); Steph. Illustr. Brit. Ent. Mand. vi. 95 (1836); Selys Mon. Lib. Eur. 50 (1840). *Sympetrum vulgatum*, Newm. Ent. Mag. i. 512 (1833). *L. flaveola*, Har. Expos. Eng. Ins. 156, t. 46, 4 (1782). *L. ruficollis*, Charp. Lib. Eur. 80, t. 11, f. 2 (1840). *L. sicula*, Hag. Syn. Lib. Eur. 35, n. 14 (1840). *L. macrocephala*, Selys Rev. Zool. 245 (1841). *Diplax vulgata*, Evans Brit. Lib. 27, pl. 20, f. 3 (1845). *L. variegata* (?),* Müll Faun. Fridr. 62, n. 548 (1764).

[Kirby looks upon this insect as a variety of *Sympetrum vulgatum* (Kirby Syn. Cat. Neur. Odon. 14, 1890); but probably most entomologists consider them distinct species. **Synonymy of S. vulgatum**: *Libellula vulgata*, Linn. Syst. Nat. i. 543, n. 3 (1758); Linn. Faun. Suec. 372 (1761); Charp. Lib. Eur. 79, t. 11, f. 1 (1840); Selys Rev. Odon. 45 (1850); Hag. Ent. Ann. 44 (1857); *Sympetrum vulgatum*, McLach. Cat. Brit. Neur. 11 (1870)].

Charpentier's description.

Haec Lib. praecedente (*i.e.*, *L. nigripes* = *S. sanguineum*) paullulo maior, et in utroque sexu eiusdem magnitudinis

*M. Hagen suppose que la *striolata* répond à la *variegata* de Müller. Aujourd'hui même nous ne pouvons guère diagnostiquer facilement la *vulgata* de la *striolata*, mais lors même que l'espèce de Müller serait celle-ci, on ne pourrait lui restituer le nom de *variegata*, car il était déjà appliqué par Linné à une espèce de l'Inde. (De Selys, "Revue des Odonates," p. 44).

est. *Caput* globosum, flavidum ; maris adulti frons semper flavida. Oculi gilvi, superne rufo-brunnei. Tempora flava, glabra, maculis nonnullis minus distinctis nigris. *Truncus :* Prothorax ater, opacus, postice in lobos duos semi-orbiculares elevatus : margine antico et postico flavo. Alitruncus lurido-luteus, in lateribus sulphureus, lineis nonnullis atris. Collaris margo anticus colore vix nigro terminatus. Tubercula interalaria maris adulti rufa. *Alae* hyalinae, ad basin non coloratae : maris venis rufis, foeminae luteis : illius parastigmate fusco, huius lutescente. *Pedes* flavo-lutei, femoribus utroque latere, tibiis interno linea atra pictis. *Abdomen* teres, cylindricum, ad basin subglobosum, in medio leviter attenuatum, versus apicem crassius, et in summo apice denuo attenuatum, id quod etiam de foemina valet. Color abdominis maris idem est, atque in Lib. nigripede [*i.e.*, Maris abdomen rubrum, segmento primo ultra dimidium, secundo ad apicem nigris : segmenta omnia ad apicem prope carinam dorsalem lineolam utrimque habent atram, transversalem, subimpressam. Segmenti octavi ac noni dorsum gerit maculam mediocrem atram, et margines atro colore circumsepti sunt]. Foeminae color e luteo aliquantulum in lurido-viridem transit, et macula nigra in segmento octavo et nono tam magna et dilatata plerumque est, ut totum fere segmentum impleat, et in medio utriusque lateris disculus maneat luteus. Caeterum margines omnes ac suturae linea tenui, atra terminantur. In ipsis segmentorum lateribus, praecipue mediorum, adiacet lineola longitudinalis, atra, abbreviata, basin singulorum segmentorum non attingens. Valva aperturae oviparae incumbens, in margine antico paullulum excisa. (T. de Charpentier, "Libellulinae Europaeae," p 78, 1840.)

Linnæus' description of L. vulgata.

[L. alis albis, corpore fusco; cauda simplici (Syst. Nat. i. 543 n. 3, 1758). *Alæ* albæ, puncto marginali rufo-fusco. *Corpus* nigricans, *anus* absque appendice (Faun. Suec. 372, 1761). De Selys (Rev. Odon. 47) is satisfied that this description refers to the true *vulgata*, and not to *striolata*.]

Size.

Length of Male, 39mm. to 43mm.; expanse of wings, 56mm. to 62·5mm. Length of Female, 39mm. to 42·5mm.; expanse of wings, 58mm. to 63mm.

Male Imago.

Face and *vertex* dull yellowish, with a black line bounding the vertex in front. *Eyes* reddish-brown. *Thorax* brown and hairy, prothorax dark brown; sides of thorax with three oblique bands bounded by black lines, the middle band brownish, the others yellow; projections at base of wings scarlet. *Legs* black below, chiefly yellow above, tarsal joints black. *Wings* hyaline, just tinged with saffron at the base; nervures reddish-brown; ante-cubital nervures 8, post-cubital 6. *Pterostigma* ruddy, bounded above and below by a strong black nervure. *Accessory membrane* rather small, narrow, whitish. *Abdomen* cylindrical, slightly swollen at the base, expanding but little at the seventh and eighth segments. Colour scarlet on the dorsal surface, with the divisions between the segments yellow, and two tiny dorsal black spots on the posterior parts of segments 3 to 8 surrounded with yellow; mid-dorsal keel yellowish, lateral keels black; the basal parts of the first and second segments black; on segments 8 and 9 a mid-dorsal basal black spot extending more or less posteriorly; on the sides of the hinder segments a lateral black streak, not always very conspicuous. *Anal*

appendages reddish ; upper ones cylindrical, pointed ; lower one triangular, turned up slightly at the tip.

Female Imago.

Except that the scarlet colouring is absent the female closely resembles the male. It is, however, a little more bulky ; the black spots on segments 8 and 9 are so developed as to nearly fill the segments, and the black lateral streaks on the abdomen are more pronounced. In very adult specimens scarlet colouring appears along the mid-dorsal line of the abdomen and on the prominences at the base of the wings, while the pterostigma becomes ruddy ; but this is only following the general law that females tend to assume the male tints as they become very mature. The *anal appendages* are short, cylindrical, brown. *Vulvar scale* somewhat prominent posteriorly ; in the middle of its extremity there is a small notch.

Immature Colouring.

In young specimens the brown and scarlet are both replaced by pale yellowish brown ; there are two yellowish bands on the front of thorax, which can sometimes be traced in adult specimens, and the pterostigma is pale yellow. The sexes are very much alike.

Variation.

In this species there is much variation in size, and in the amount of scarlet on the adult male. The dark brown suffusion on the wings and the sepia tint of the abdomen of many females late in the season are simply due to age.

Difference between S. striolatum and S. vulgatum.

The following are some of the more important points that are usually given as separating these two insects :

S. striolatum.	*S. vulgatum.*
1. Colour more yellow.	1. Colour more olive.
2. On the sides of the thorax a brown band, between the second and third oblique black stripes.	2. Absent.
3. Less marked, if extended at all.	3. The black line on the vertex, containing the ocelli, extends downwards on each side of the face as a margin to the eyes.
4. Most nervures dark.	4. Principal nervures reddish, especially in some lights.
5. The incisions of the abdominal segments and two very small dots towards the hinder edge yellow. (Male.)	5. Abdomen without yellow dots.
6. Absent.	6. A longitudinal black line on each side of the first three segments of the abdomen. (Male.)
7. Vulvar scale slightly prominent, a little notched in the middle. (Female.)	7. Vulvar scale *very* prominent, neither notched nor sinuated.
8. Eighth and ninth segments with black spot much larger than in male. (Female.)	8. Eighth and ninth segments with a dorsal black streak as in male.
9. Mid-dorsal raised line on abdomen yellowish. (Female.)	9. Ditto blackish.

Oviposition.

While hovering on the wing, and usually held by the male *per coll.*, the female deposits her eggs, apparently quite aimlessly, by dipping the tip of her abdomen in the water.

Egg.

Elliptical in section, the major axis being about 5mm. (Fig. 4., No. 2). Contents granular. The eggs observed

were laid naturally, though not in water. About a month after being laid, the unhatched nymph could be seen inside one egg at least. When first laid they were quite pale, but before hatching became deep yellowish.

Nymph.

On pages 18 and 19 will be found some account of the early stages of this nymph, the newly-hatched insect being represented on a large scale in Fig. 6. A description of the last stage before the disclosure of the imago I have not yet been able to obtain.

Date.

June 14 is the earliest record I have been able to obtain, and in 1897 I took them on the wing as late as November 14, but they seem to be at their best during August and September.

Habits.

Though one of the commonest of British Dragonflies, the male, when full coloured, is one of the most handsome, and the appearance of this insect is sometimes enhanced by the addition of bright red patches on the basal part of the wings, caused by the presence of masses of red acari * (parasitic mites). A continental species of the same genus, *S. meridionale*, is, however, more often and sometimes more completely adorned in the same way. The insect before us has very well developed that habit often found in Dragonflies of

* E. M. M., 1864, p. 100; 1876, p. 95.

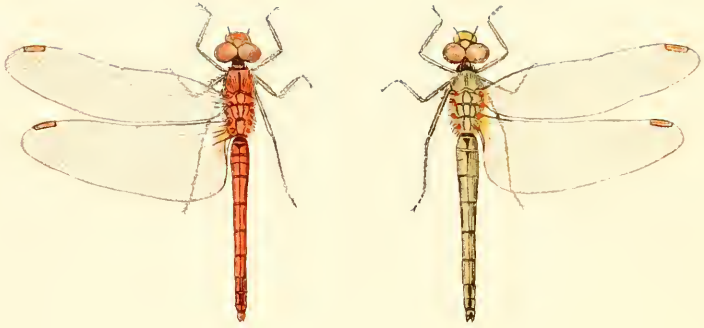
returning continually to the same spot, where it settles, often on the bare ground, after a short but exceedingly rapid flight. It is very restless and easily startled, yet, strange to say, on one occasion a male came and cautiously settled on my hand, where I caught it by the wing. When thoroughly startled, this Dragonfly often soars away to a great height. Very late in the season it becomes sluggish, and may be almost taken by the hand.

Distribution. *Common.*

This Dragonfly is well distributed throughout the British Isles, but, being a common one, records of its occurrence are not as plentiful as one might desire. *Inverness-shire:* Strathglass (J. J. F. X. King). *Argyllshire:* Island of Coll (J. J. F. X. King). *Isle of Man:* Sulby (H. Shortridge-Clarke). *Westmoreland:* Langdale (J. J. F. X. King). *Cheshire:* Delamere Heaths (J. Arkle). *Carnarvonshire:* Heaths (J. Arkle); Abersoch (J. Arkle). *Merionethshire:* Barmouth (R. C. Bradley). *Worcestershire:* Near Worcester (J. E. Fletcher); Trench Woods (W. H. Bath). *Warwickshire:* Sutton Coldfield (R. C. Bradley). *Oxfordshire:* Shotover Hill (A. H. Hamm); Brighthampton (Mr. Stone, in Oxford Museum). *Berkshire:* Near Eynsham and Godstow, near Oxford, near Kennington (W. J. L.); Wokingham and near Bagley Wood (A. H. Hamm). *Buckinghamshire:* Marlow (H. Bell-Marley). *Cambridgeshire:* Chippenham Fen (R. C. Bradley); Wicken Fen (G. T. Porritt). *Essex:* Epping (H. Doubleday); Colchester (W. H. Harwood); Wanstead Park (F. A. Walker). *Kent:* Deal and Dover District (C. G. Hall);

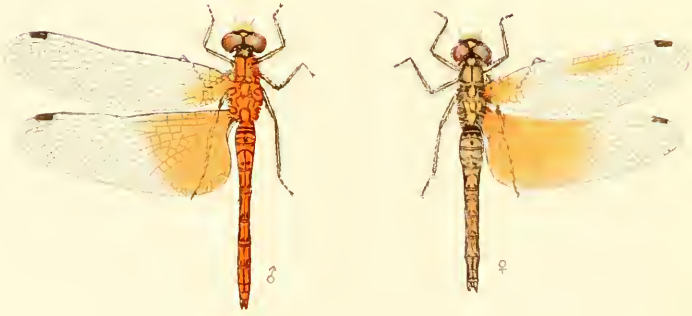
Folkestone (H. J. Turner); Herne Bay (W. H. Bath); Sandwich (W. J. L.). *Surrey:* Esher Common, Ockham Common, Richmond Park, near Thursley (W. J. L.); Bookham Common (C. A. Briggs); Bisley (A. Ficklin, jun.); Chobham Common (E. Vincent). *Hampshire:* New Forest and Sowley (W. J. L.); Wolmer Forest (H. J. Turner); Christ Church (W. H. Bath). *Isle of Wight:* Shanklin and Ventnor (W. H. Bath). *Dorset:* Near Burton Bradstock (W. J. L.). *Devonshire:* Lynmouth and Exmoor (C. A. Briggs); Stoke, Exminster, and near Plymouth (Parfitt). *Scilly Isles:* Tresco (F. Norgate); S. Mary (F. Walker). *Jersey:* S. Ouen's Bay (R. McLachlan). *Guernsey:* Grand Mare (W. A. Luff). *Ulster:* Armagh (J. J. F. X. King); Glasslough, Co. Monaghan (K. J. Morton). *Leinster:* Killucan and Waterston (J. J. F. X. King). *Munster:* Torc Cascade, Horses' Glen, Ross Castle, Dinish, and Coppagh Glen (J. J. F. X. King); Skibbereen, co. Cork (Nat. Gazette, April, 1889). *Connaught:* Broad, Kip, Prospect, and Carrowbeg Loaghs, Carrowbeg River, Mackree Castle, and Yew Point (J. J. F. X. King). *Sympetrum vulgatum* does not appear to be a British insect, although Mr. C. A. Briggs has a male which he took at Bookham Common in 1891, and Dr. Hagen mentions in the *Entomologists' Annual*, for 1857, a female taken near Hull, on the authority of Mr. J. C. Dale. At the sale of the late Mr. Desvignes' collection, Mr. McLachlan obtained a male, but there was no clue to the locality from which it came.*

* E. M. M., p. 220, 1869.



Sympetrum fonscolombii

(nat. size).



Sympetrum flaveolum

(nat. size).

3. Sympetrum fonscolombii, Selys.

(Plate II.).

Synonymy.

Libellula fonscolombii, Selys Mon. Lib. Eur. 49 (1840); Selys Rev. Odon. 37 (1850). *L. fonscolombis*, Hag. Ent. Ann. 43 (1857). *Sympetrum fonscolombii*, McLach. Cat. Brit. Neur. 12 (1870); Kirby Syn. Cat. Neur. Odon. 14 (1890). *L. flaveola*, Fonsc. Ann. Soc. Ent. Fr. vi. 144 (1837). *L. erythroneura*, Schneid. Stett. ent. Zeit. vi. 111 (1845).

De Selys' description.

Diagnose. Parastigma grand, jaune. La base des ailes inférieures et un vestige à celle des superieures jaune-safrané. Les cuisses noires, jaunes en dehors. Abdomen à peine plus court que les ailes, jaunâtre (rouge chez les males adultes). (E. De Selys-Longchamps, "Monographie des Libellulidées d'Europe," p. 49, 1840. He also gives a comparison with *S. vulgatum*).

Size.

Length of Male, 39mm.; expanse of wings, 60mm. (a continental specimen). Length of Female, 39·5mm; expanse of wings, 64mm. (a Spanish specimen, probably rather large).

Male Imago.

Head. Face red, shading to yellow at the sides. *Eyes* reddish-brown above, bluish-grey beneath, changing to blackish after death. Lower *lip* dusky, upper bright red;

vertex brownish, preceded by a black line descending along the eyes; behind the eyes bright yellow, with a brown-black band at each end of the yellow patch, and one intersecting it. Prothorax blackish, russet behind, hairy at the margin. *Thorax* downy, red, with the raised prominences carmine, interspersed with dull black. Sides red, with two irregular yellowish bars, one about the centre, the other basal These bars have sometimes a bluish tint. Between the bars and the legs is a small bright blue patch. *Wings* hyaline, *nervures* carmine, becoming darker after death, a saffron patch at the base of the hind-wings, sometimes also indicated on the fore-wings. *Accessory membrane* rather small, white. *Pterostigma* yellowish to pale reddish-brown, enclosed within two strong black nervures. 3mm. long. *Legs* black at sides, yellowish-brown in centre, tarsi black. *Abdomen* cylindrical, not constricted at the third segment, blood-red, fading to brownish-red after death. The base of the first segment is black, followed by a thin red line, this again being succeeded by a black patch extending over about half of the second segment in front, but extending dorsally back into a point. In some specimens there is a small black dorsal spot at the commencement of the third and fourth segments. A black dorsal blotch on segments 8 and 9 extends over nearly the whole length of the segment. On each side of segments 7, 8, and 9 is a lateral black streak. *Appendages* superior, scarlet, almost as long as the last two segments, slightly elbowed, with about ten black points beneath, tips black; inferior, nearly triangular obtuse, yellowish, blackish towards tip. (Mr. C. A. Briggs' description from Surrey specimens.)

Female Imago.

Face conspicuously yellow. The crimson of the male is replaced by yellowish-brown. Hind-wings slightly tinged with saffron at the base. *Pterostigma* bright yellow, enclosed within two strong black nervures. *Anal appendages* cylindrical, sharp, orange, about as long as the last segment but one. *Vulvar scale* short, notched.

Immature Colour.

The male resembles the female in the absence of the red colouring. The pterostigma, the costal nervure, and the lines on the legs (except the hind ones) only take on a reddish colour in very adult specimens. (De Selys.)

Early Stages.

It is extremely unlikely that *S. fonscolombii* ever breeds in the British Isles.

Date.

Surrey specimens in June, 1892. July and August in Belgium (De Selys).

Habits.

Mr. C. A. Briggs speaks thus of the appearance and habits of the males of this species, as observed by him in Surrey in 1892: "When alive this Dragonfly is certainly a magnificent one, the vivid colouring being very conspicuous even when the insect is on the wing. Its flight is generally similar to that of its congener *striolatum*, the insect occasionally settling on bare damp spots near the water. But on one very hot day

I noticed them settling with drooping wings on the flowers of rushes growing in the shallows some little distance from the edge of the pond, the rushes bending with their weight. Here they were safe, for though I spent a long time in pursuit, wading after them in water above my knees, yet, even when an occasional cloud was passing, they always leisurely 'moved on' just when I laboriously got nearly within striking distance. Some were affected by a dark carmine-coloured acarus, and on one specimen I counted eighty-five."

Migration.

There can be no doubt that the specimens of this insect taken by Mr. C. A. Briggs and his brother in Surrey in 1892 were part of an immigrant swarm, about which, says the former, two points are worth attention: "First, the total absence of the female. Though no doubt, as a rule, in this genus the female is either much rarer or is of more retired habits than the male, still if the female had been there, one at least must have been seen, as we were specially on the look-out for them. The other point is that the extremely early date would seem to shew that they must have come from a much warmer climate, possibly North Africa." *

Occurrence.

On Ockham Common, in Surrey, in June, 1892, the Messrs. Briggs took seventeen males, the first twelve

* E. M. M., 1893, p. 9.

being captured on the 8th, and the last two on the 17th. The locality was a very restricted one, as they only occurred at one portion of one pond, although two other ponds were within a hundred yards.* There have been but three, or perhaps four, previous occurrences of this Dragonfly in Great Britain. The oldest is a female in Mr. J. F. Stephens' cabinet,† now in the British Museum, supposed to have been taken near London. The next, a male, formerly in Mr. T. Devignes' collection, is now in Mr. McLachlan's cabinet.† The third, also a male, was taken in 1881 at Deal, and is now, I believe, in the Dover Museum.‡ It has been mentioned that one taken at Exmouth was exhibited at the Entomological Society in 1887, but there seems to be no record of it in the Proceedings.

4.—Sympetrum flaveolum, Linn.

(Plate II.)

Synonymy.

Libellula flaveola, Linn. Syst. Nat. 543, n. 2 (1758); Steph. Illustr. Brit. Ent. Mand. vi. 96 (1836); Charp. Lib. Eur. 74, t. 9 (1840); Selys Mon. Lib. Eur. 45 (1840); Selys Rev. Odon. 33 (1850); Hag. Ent. Ann. 43 (1857). *Diplax flaveola*, Evans Brit. Lib. 28,

* E. M. M., n.s., iii., p. 194; iv., p. 9. † E. M. M., xx., p. 253.
‡ E. M. M., xxi., p. 21; xxv., p. 103.

pl. xxi., f. 2 (1845). *Sympetrum flavcolum*, McLach. Cat. Brit. Neur. 12 (1870); Kirby Syn. Cat. Neur. Odon. 13 (1890). *Lib. flavcolata*, Linn. Faun. Suec. 372, n. 1460 (1761). *Symp. flavcolatum*, Newm. Ent. Mag. i. 513 (1833-8). *Lib. rubra*, Müll. Faun. Ins. Fridr. 62, n. 550 (1764). *Lib. aurea*, Scop. Ann. Hist. Nat. v. 120 (1772). *Lib. flavescens*, Fisch. Vers. Nat. Liv. 335 (1778). *Lib. victoria*, Fourcr. Ent. Par. ii. 348, n. 16 (1785). *Symp. aurantiacum*, Buch. Syst. Ent. Odon. 9, t. 8, f. 1 (1878)

Linnæus' description.

L. alis basi luteis. . . . Hæc inter minores; variat rarius alis absque basi lutea; forte sexu (C. Linnæus, "Systema Naturæ." Ed. x. 543, n. 2, 1758). . . . *Lib. flavcolata* alis albis basi luteis. DESCR. *Dorsum* luteum; subtus tota nigra; *thorax* niger utrinque maculis duabus obliquis flavis, præter lineas duas flavas, precedentes. *Pedes* nigri. *Frons* virescens. *Oculi* grisei. *Alæ* omnes basi lata flava macula (C. Linnæus, "Fauna Suecica," p. 372, n. 1460. Ed. ii. 1761).

Size.

Length of Male, 31mm. to 37mm.; expanse of wings, 48·5mm. to 60mm. Length of Female, 33mm.; expanse of wings, 56mm. (Female measurements from two continental specimens).

Male Imago.

Face yellowish-brown, lower lip reddish, with middle lobe black, frons pale red; a distinct black line in front of the vertex extending along the side of the eyes. *Eyes* dull reddish. *Thorax* deep red, with the projec-

tions at the base of the wings crimson; on the sides three oblique black lines, the middle one being short. *Legs* black, with a yellowish line along the tibiæ and hind femora. *Wings* hyaline, the basal third of the hind-wings saffron, and a smaller patch at the base of the fore-wings of the same colour; costa and other nervures near it yellowish. *Pterostigma* 3mm. long, red, between two black nervures. *Accessory membrane* whitish, small. *Abdomen* nearly cylindrical, but little contracted after the third segment, not widened in the region of the eighth; in colour pale red, somewhat of the tint known amongst artists as "light red"; first segment nearly all black, base of second black; a small black mark on the dorsal line of segments 8 and 9; two tiny black spots near the posterior margin of segments 3 to 7; a black line along each side of segments 3 to the end. *Anal appendages*, upper as long as ninth segment, cylindrical pointed, brown at base, tips black; lower dark brown, short, truncate, turned up slightly at the distal edge, whose margin is slightly concave.

Female Imago.

In the female olive-yellow takes the place of the red colouring of the male, except in the case of the pterostigma, which is red in the female also. Besides this there are few points of difference. The *pterostigma* is a little longer; there is usually a saffron patch on the wings near the cubital point, and that on the hind-wings is generally of larger size than in the male. The *vulvar scale* is not prominent. The *anal appendages* are about as long as the ninth segment and coloured like those of the male

Immature Colouring.

In colour the immature male closely resembles the female, and both, when lately emerged, have the pterostigma yellow.

Variation.

Besides great difference in size, there is also a wide variation in both directions of the amount of the wing coloured with saffron; sometimes it is very extended, at others almost obsolete. Occasionally the basal patch on the fore-wings of the female is joined to that near the cubital point, forming a saffron band. The cubital saffron patch is occasionally found on the fore-wings of the male.

Early Stages.

It is probable that this species seldom breeds in the British Isles.

Oviposition.

There is, however, a description in the E. M. M. of the method of oviposition observed on August 27, 1871, in which year the species was very abundant near London. It is related that numbers of pairs that day, which was hot, swept down from the hills and kept hovering over a small, shallow pond at the bottom of Shirley Heath, near Croydon. Each male kept its hold on the neck of the female with its anal claspers, thus almost completely controlling her actions. Hovering steadily at about half-a-foot's distance above the water, each male jerked his partner violently down to the level of the water; then, dragging her up again, he just shifted

his position to a little distance and repeated the process; each time the surface was beaten by one stroke, and only the abdomen of the female touched the water. Continued observation made it clear that but one egg was dropped at a time, and that loosely, in the water.*

Egg.

The observer referred to above secured an egg, just laid, and the female that laid it, with her partner. The egg was solitary, almost globular, pale amber-coloured, ½mm. in diameter. She laid afterwards 123 more, each loosely, in a box. A dying female, however, deposited her eggs in one bunch in a box, but they appeared not to be impregnated, and were got rid of in her dying struggles.

Date.

August and September seem to be the only months recorded for this species in England, but De Selys says it is often found in Belgium in October, and even in the beginning of November.

Habits.

On Ockham Common, in Surrey, and near Elstead, in the same county, in September, 1898, this Dragonfly seemed to like to flit about and settle at every few yards, either on the ground or on the herbage, after the manner of many of the brown butterflies. In the former locality it appeared to make for the blossoms of the Marsh S. John's Wort (*Hypericum elodes*), though, of

* A. Müller, E. M. M., 1871, p. 127.

course, this might have been only accidental. The manner of flight resembled closely that of *S. sanguineum*, and somewhat that of *S. scoticum*, but was by no means so continued as that of *S. striolatum*. The saffron of the wings was not very noticeable in flight, nor even when the insect was settled.

Migration.

There is little doubt that in 1871 a considerable migration of this species took place into the London district, on which occasion Mr. McLachlan even saw several examples in the Strand,* and Mr. H. Doubleday seems to hint at the same thing having occurred on former occasions.† The year 1898 witnessed apparently another, though perhaps small, invasion, which, from the localities recorded, may have come across the North Sea.

Distribution.

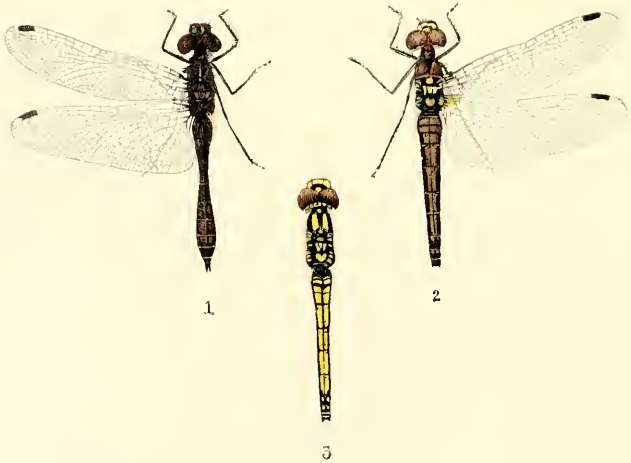
Localities for this species in Britain are few. In 1871, as already mentioned, it was very abundant in the *London District*, and writing in the same year Mr. H. Doubleday speaks of its having been very common in certain years among the gravel-pits on Coopersale Common, *Epping*, in August and September. In August, 1888, Mr. G. T. Porritt took one specimen on the Sandhills, near *Deal*.‡ Mr. W. A Luff records several at *Grande Mare* and *L'Ancresse*, in Guernsey, about 1891.§ In 1898 this species was found in some

* E. M. M., 1884, p. 253. † E. M. M.,1871, p. 86.
‡ E. M. M., 1889, p. 214. § E. M. M., 1892, p. 73.



Sympetrum sanguineum

(nat. size).



Sympetrum scoticum

(nat. size).

1, MALE IMAGO; 2, FEMALE IMAGO; 3, FEMALE IMAGO (Immature Colouring).

numbers by myself (only males taken) in September at Ockham Common, in *Surrey*, and one was seen later near Elstead. On August 21, Mr. A. H. Hamm took a male in Berkshire, near *Oxford*, and on August 31 a male was captured near *Colchester* by Mr. W. H. Harwood, who had also taken a specimen in that neighbourhood on a former occasion. Curtis says of *flavcolata* "taken by Mr. Lyell, at Kinnordy, in Forfarshire," while Mr. C. W. Dale informed Mr. Briggs that it used to occur at Whittlesea Mere every year. De Selys* says that it has been found in *Scotland*, but not in *Ireland*.

5. Sympetrum sanguineum, Müll.

(Plate III.)

Synonymy.

Libellula sanguinea, Müll. Faun. Ins. Fridr. 62, n. 547 (1764); Selys Rev. Odon. 31 (1850); Hag. Ent. Ann. 44 (1857). *Sympetrum sanguineum*, McLach. Cat. Brit. Neur. 12 (1870); Kirby Syn. Cat. Neur. Odon. 15 (1890). *Lib. vulgata* (probably this species), Harr. Expos. Eng. Ins. 156, t. xlvi., f. 3 (1782). *Lib. flavcola*, Lind. Mon. Lib. Eur. 15 (1825). *Symp. rufostigma*, Newm. Ent. Mag. i. 512 (1833). *Lib. rufostigma*, Steph. Illustr. Brit. Ent. Mand. vi. 95 (1835). *Diplax rufostigma*, Evans Brit. Lib. 27, pl. xix., f. 3-4 (1845). *Symp. basale*, Newm. Ent. Mag. i. 513 (1833). *Lib. basalis*, Steph.

* "Revue des Odonates," p. 35.

Illustr. Brit. Ent. Mand. vi. 96 (1835). *Dip. basalis* Evans Brit. Lib. 28, pl. xxi., f. 1 (1845). *Lib. angustipennis*, Steph. Illustr. Brit. Ent. Mand. vi. 95 (1835). *Dip. angustipennis*, Evans Brit. Lib. 27, pl. xx., f. 2 (1845). *Lib. rœselii*, Curt. Brit. Ent. xv., fol. 712 (1838); Selys Mon. Lib. Eur. 47 (1840). *Lib. nigripes*, Charp. Lib. Eur. 77, pl. x., f. 1 (1840).

Müller's description.

Libellula sanguinea, alis hyalinis puncto marginali ferrugineo: dorso sanguineo. (O. F. Müller, "Fauna Insectorum Fridrichsdalina," p. 62, n. 547, 1764.)

Size.

Length of Male, 33mm. to 36mm.; expanse of wings, 50mm. to 57mm. Length of Female, 33mm. to 36mm.; expanse of wings, 53mm. to 58mm.

Male Imago.

Face deep yellow; frons of a reddish tint; lower lip deep red; a distinct black line in front of the vertex, extending along the side of the eyes. *Eyes* dull reddish. *Prothorax* dark anteriorly, brown behind. *Thorax* red-brown, with three oblique lateral black lines; attachments of the wings crimson. *Wings* hyaline, the base of the hind-wings and a slight touch at the base of the fore-wings saffron; nervures deep red of a blackish appearance. *Pterostigma* about 2·5mm., deep red between two black nervures. *Accessory membrane* narrow, dark except at base. *Legs* black. *Abdomen* deep rich crimson, short, much compressed about the fourth segment and dilated about the seventh and eighth; nearly the whole

of the first segment, and the base of the second, black; a pair of tiny, posterior, dorsal black spots on segments 3 to 7; a mid-dorsal black streak along segments 8 and 9; each lateral ridge of abdomen black. *Anal appendages* russet, the superiors cylindrical, pointed, longer than the ninth segment; lower one shorter, triangular, blunt, black-tipped.

Female Imago.

In the female the crimson colouring is replaced by yellowish-olive, except as regards the pterostigma, which is deep ruddy, and the eyes which are reddish-brown above. *Abdomen* compressed beyond the second segment, and not dilated at all posteriorly; powdered with white below. *Anal appendages* russet, about as long as the ninth segment. *Vulvar scale* not prominent. *Pterostigma* a trifle longer than in male. According to De Selys, in very old specimens the dorsal surface of the abdomen is more or less red. *Base of fore-legs* yellowish.

Immature Colouring.

Absence of crimson in both sexes is, generally speaking, the characteristic of the immature state, its place being taken by a yellow-brown tint. The saffron colour is often more extended on the wings. The pterostigma is light grey or blackish. De Selys mentions that the nervures of the wings are black, and that the interior of the two fore femora is yellow.

Variation.

This species does not seem subject to much variation, if we leave out of consideration the colour of the

pterostigma, and the amount of saffron suffusion on the wings, the differences in both of which seem usually to be due to the age of the specimen. In the south of Europe there is sometimes a tendency to decrease in size, or suppression of, the black dorsal streak on segments 8 and 9, while the yellow on the inside of the fore femora tends at the same time to remain in the adult.*

Egg.

Elliptical in outline; in fact, nearly circular. Minor axis about half a millimetre, major axis a trifle greater. Colour, after being kept in a solution of formalin for about three weeks, yellowish, sometimes with a tinge of brown. Contents, granular or oily. There did not seem to be any pedicel. [The eggs, from which this description was obtained, were a few extracted from the dead body of a female caught near Sandwich in the middle of August, 1898.]

Nymph.

Body of the usual sepia tint, broad and somewhat flattened; length, including anal appendages, 17mm. to 18mm.; greatest breadth, 7mm. *Head* of moderate size, in outline a flattened pentagon; width 5·5mm. *Antennæ* of seven joints, the basal two being short and rather swollen, the rest more slender. *Mask* tapering backward to the joint which is situated between the insertion of the fore- and mid-legs, narrow at joint, spoon-shaped, covering the face; palpi broad where they approach one another,

* De Selys, "Revue des Odonates," p. 32.

and there serrated; teeth reddish; middle lobe of mask produced in an obtuse angle. Several whitish markings in front of the *vertex*, which is itself pale and conspicuous. *Eyes* prominent, hemispherical, situated at the fore corners of the head. *Top of head* slightly convex. *Occiput* rather broad, rough; hind margin nearly straight. *Prothorax* collar-like, a dark patch in centre; hind margin convex, edged behind with a ring of hairs. *Meso-thoracic spiracles* dark, very conspicuous. *Legs* long, slender; fore-legs 10mm. long, mid-legs 11mm., hind-legs 16mm.; femora ringed with two slightly darker brown bands; distal extremities of joints dark, especially of tarsi; fore- and mid-tibiæ slightly hairy, hind- apparently not, but rather spiny. *Wing-cases* about 5mm. long. *Abdomen* with pale, long, slender, recurved, mid-dorsal spines on segments 6, 7, and 8; a pair of lateral spines on 8 and 9, those on 8 being of moderate length, those on 9 conspicuously long—equal in length to the last two segments. Segment 9 truncated behind, 10 small. On each side of the mid-dorsal line a longitudinal line of brown spots, preceded by a whitish suffusion. Outside this row, on each side, more brown and pale spots. At the lateral carinæ on each side on the posterior part of each segment a white patch. Abdomen not conspicuously marked below. *Anal appendages* short; *upper* triangular, pointed; *laterals* shorter; *lower ones* nearly half as long again as upper.*

* Described from a nymph-skin found on Ockham Common, Surrey, July 16, 1898. From what was known of the *Sympetra* of the district, it was concluded that the skin might belong to *sanguineum*. *Striolatum* was excluded simply on the strength of Nunney's figure in "Science Gossip," 1894, p. 101, which must be looked upon as incorrect, for this year (1899), when *S. striolatum* was emerging, empty skins were again

Date.

This Dragonfly seems to have been oftenest taken in England in August and September. It is out, however, at least by the middle of July, and Mr. H. Doubleday speaks of its being found in October. In 1898 I took an immature male near Sandwich on August 20, although many specimens on the same day were much worn.

Habits.

Its colour might cause this insect to be confused with *S. striolatum*, but the crimson tint is much richer and more pronounced than in the common species, and it is not much larger than *S. scoticum*, which it resembles in shape. It has a short, jerky flight, and often settles. Though restless and easily startled, yet, after being struck at and missed, it will often keep returning to the same spot. It rests sometimes with wings bent down over its sides, as has been mentioned of other species of the genus.

Migration.

Perhaps this species sometimes visits us from the Continent, and possibly 1898 may have witnessed such an immigration on a small scale with *S. flavcolum*.

found, and the fact that they belonged to that species, and not to *sanguineum* was clearly established. The identity of the nymph was discovered, unfortunately, only after the sheet containing the account of *striolatum* had gone to press, and so too late to enable the description of the nymph to be removed to its proper place on p. 74. This discovery will also necessitate an alteration on p. 42. The doubtful diagnosis of the nymph of *striolatum* must be ignored, and that of *sanguineum* below, which is also queried, must be read as belonging to *striolatum*.

Distribution.

Not many localities seem to be recorded for this species in Britain, but perhaps it only needs searching for and carefully discriminating from *S. striolatum* to give it a much better footing amongst us. The species does not seem to have occurred in Scotland or Ireland. *Cambridgeshire:* Thorney and Knarr Fen Dykes (K. J. Morton); Littleport, near Ely (C. A. Briggs); Wicken (W. J. Ashdown). *Kent:* Deal and Dover district (C. G. Hall); Gravesend (H. J. Turner); Sandwich (W. J. L.). *Essex:* Epping neighbourhood, on Coopersale Common (H. Doubleday); Leigh (C. A. Briggs); Colchester (W. H. Harwood). *Huntingdonshire:* Monks Wood (K. J. Morton). *Buckinghamshire:* Marlow (H. W. Bell-Marley). *Surrey:* Ockham Common, one (W. J. L.).

6.—Sympetrum scoticum, Don.

(Plate III.)

Synonymy.

Libellula scotica, Don. Brit. Ins. xv., t. 523 (1811); Steph. Illustr. Brit. Ent. Mand. vi. 94 (1835); Selys Mon. Lib. Eur. 53 (1840); Selys Rev. Odon. 48 (1850); Hag. Ent. Ann. 44 (1857). *Sympetrum scoticum*, Newm. Ent. Mag. i. 511 (1835); McLach. Cat. Brit. Neur. 12 (1870); Kirby Syn. Cat. Neur. Odon. 13 (1890). *Diplax scotica*, Evans Brit. Lib. 27, pl. xix., f. 1, 2 (1845) *Lib. cancellata*, Müll. Faun. Ins. Fridr. 61, n 537 (1764), *Lib. tricdra*, Müll. Nov. Act. Leop.-Carol. iii. 129,

n. 19 (1767). *Lib. veronensis*, Charp. Hor. Ent. 46 (1825). *Lib. pallidistigma*, Steph. Illustr. Brit. Ent. Mand. vi. 94 (1835); *Diplax pallidistigma*, Evans Brit. Lib. 27, pl. 20, f. 1 (1845). *Lib. nigricula*, Eversm. Bull. Mosc. ix. 240, t. 1, f. 1-2, (1836). *Lib. nigra*, Charp. Lib. Eur. 83, t. xii. (1840). [*Lib. flaveola*, Linn. Syst. Nat., and *Lib. flaveolata*, Linn. Faun. Suec., seem to refer partly to this species.]

Donovan's description.

Thorax with two oblique yellow bands. . . . Male. Wings transparent, with deep black stigma; abdomen blackish. . . Female. Wings transparent, with deep black stigma, and yellow base; abdomen yellow, with two black lines on each segment. (E. Donovan, "The Natural History of British Insects," vol. xv., t. 523. 1792—1813.)

Size.

Length of Male, 31 to 34mm.; expanse of wings, 48 to 51·5mm. Length of Female, 27·5 to 33mm.; expanse of wings, 42·5 to 52mm.

Male Imago.

Head and *face* black as a whole, but sides of nasus and frons yellow, and of the labium orange-brown; some yellow spots also behind the *eyes*, which are dark brown. *Prothorax* black. *Thorax* black; on the sides two oblique yellow bands separated by a black one containing a line of three yellow spots; two yellow spots also in front of the anterior yellow line; on the meta-sternum three yellow spots somewhat in the form of a fleur-de-lys; attachments of wings, and projections between them, dark brown or yellowish-brown. *Wings*

hyaline ; nervures black. *Pterostigma* 2mm. long, rather broad, black. *Accessory membrane* narrow, whitish. *Legs* black. *Abdomen* short, much constricted about the fourth segment, and dilated about the seventh and eighth ; black except for a dark olive lateral suffusion on segments 2 and 3. *Anal appendages* black ; upper cylindrical, pointed, as long as the ninth segment ; lower shorter, triangular.

Female Imago.

On the *face* the yellow colour is better developed than in the male, especially on the frons ; the vertex also is yellow. The attachment of the wings yellow, and projections between them yellowish. A conspicuous saffron patch at the base of the hind-wings, and a touch of it on the same part of the fore-wings. *Pterostigma* longer than that of the male. The *coxæ* tend to remain yellow as in immature specimens. *Abdomen* compressed, not constricted and then dilated ; the upper surface is chiefly orange-brown, this colour gradually decreasing in amount towards the posterior extremity ; there is a black band across the first segment, as well as one produced centrally behind into an obtuse point along the base of the second segment ; generally a more or less distinct mid-dorsal black line, especially on the basal segments, except the first ; two large yellow spots at the base of the second segment below. *Anal appendages* black, cylindrical, pointed, nearly as long as the ninth segment ; eleventh segment orange. *Vulvar scale* pointed and very prominent. Other particulars, especially the distinctive markings on the thorax, resemble those of the male.

Immature Colouring.

The male closely resembles the female, the markings in both being bright yellow, and distributed as in the adult female. The coxæ are yellow also. The pterostigma is pale yellow between black nervures. *L. pallidistigma* of some authors is evidently an immature form of this species. De Selys says * that Hagen often noticed the pairing of specimens with pale pterostigmata, in which case consequently the male was not black. The difference in appearance between mature and immature males is most striking, and, unless care is used, will lead to confusion with those not much acquainted with the genus *Sympetrum*.

Variation.

Size is rather inconstant in this species. In other respects the male does not exhibit much variation. In the female the distribution of the yellow markings on the abdomen varies to some extent, as does also the amount of saffron suffusion on the wings. Sometimes this spreads a little along the costal region of the fore-wings, and even becomes slightly more intense near the cubital point, as in *S. flavcolum*. I have a female in which a good part of the fore-wings is tinged with brown, as in old specimens of *S. striolatum*.

Oviposition.

The method of procedure resembles that of *S. striolatum*, and is fully described in De Selys' "Revue des Odonates," pp. 344, 345.

* "Revue des Odonates," p. 49.

Egg.

Length about ·5mm., breadth about ·3mm.; shape nearly elliptical—perhaps slightly oval, the greatest width being rather nearer the tiny pedicel. Slightly granulated. Colour yellowish-white, but many became dark ruddy brown. [Laid by a female caught about September 15, 1897.]

Nymph.

Body the usual sepia colour of a very uniform tint; broad, somewhat flattened; length, including anal appendages, 16mm., greatest breadth 6mm. *Head* of a somewhat triangular appearance, the base being anterior and the apex (truncated) in the occipital region; width of head, 5mm. *Antennæ* seven-jointed, basal two swollen, distal five slender. *Mask* tapering backward and reaching at the hinge about to the insertion of the mid-legs; narrow at the hinge; spoon-shaped, covering the face; palpi broad where they approach one another in the mid-line, and there toothed; teeth reddish; middle lobe produced in a very obtuse angle. *Eyes* prominent, conical, situated at fore corners of head; very forward. *Top of head* rather convex. *Occiput* fairly broad, slightly hairy; hind margin a little concave (nearly straight). *Prothorax* collar-like, rather broad, margined behind with a line of hairs; hind border convex. *Meso-thoracic spiracles* dark, conspicuous. *Legs* very long and slender; first pair about 9mm. long, mid 11mm., hind 14·5mm.; mid- and fore-tibiæ hairy, hind ones spiny rather than hairy; femora ringed with two rather indistinct darker bands. *Wing-cases* nearly 5mm. long. *Abdomen* unspotted; short, mid-dorsal recurved spines on segments

6 and 7; very short lateral spines on 8, rather longer on 9; segment 9 slightly truncated behind, 10 very small. *Anal appendages* small; *upper* one triangular, pointed; *laterals* shorter and slender; *lower ones* rather longer than upper, pointed. [Description made from empty skins found on Esher Common, July 18, 1897, when the species was emerging.]

Date.

This species usually first appears at the beginning of July in Surrey, though I have a record for it as early as June 6 in Delamere Forest. It continues on the wing till well into October, my latest capture being October 17, 1897, in Surrey. It is worthy of note that a female was taken in 1898 as late as Sept. 25 with the immature colouring.

Habits.

Generally speaking, the flight of *S. scoticum* is not long-continued, and it has the habit of often returning to the same spot, though when thoroughly disturbed it sometimes soars away out of sight amongst the trees. Its capture is not always an easy matter, for if of short duration its flight is rapid, and the dark colour of the insect does not allow the eye easily to follow its movements. On hot days it delights to settle on the tops of broken reeds and sticks, on the trunks of trees, or even on the bare ground, to sun itself. Let the observer remain perfectly still, and his hand or some light part of his dress may induce the insect to display the greatest familiarity, to be repaid of course by immunity from capture.

Distribution.

In all three parts of the British Isles this interesting little Dragonfly is to be found, though it is usually considered to be more plentiful in the North. Whether, as records increase in number, this will be found to be borne out in fact, remains to be seen. Localities:

Inverness-shire: Glen Cannich, Strathglass, and Kinrara (J. J. F. X. King). *Argyllshire:* (G. T. Porritt); Lock Awe (Leach, *teste* Donovan). *Perthshire:* (A. M. Rodger). *Stirlingshire:* Bog of Bannockburn (Leach, *teste* Donovan). *Westmoreland:* Langdale (J. J. F. X. King). *Lancashire:* North (J. Arkle). *Cheshire:* Delamere Forest (J. Arkle). *Yorkshire:* Thorne Moor and Riccall Common (G. T. Porritt). *Cambridgeshire:* Knarr Fen and Thorney (K. J. Morton); *Essex:* Near Epping (H. Doubleday). *Devonshire:* Exmoor (C. A. Briggs). *Hampshire:* Bournemouth (R. C. Bradley); New Forest (W. J. L.). *Sussex:* Near Liphook (H. J. Turner). *Surrey:* Esher Common, Ockham Common, and near Elstead (W. J. L.); Bookham Common (C. A. Briggs); Richmond Park (W. J. Ashdown); Bisley (A. Ficklin, jun.); Weybridge (J. E. Tarbat). *Merionethshire:* Barmouth (R. C. Bradley). *Guernsey:* Chêne (F. V. Theobald). *Ulster:* Glasslough, Co. Monaghan (K. J. Morton). *Leinster:* Bog of Allan (J. J. F. X. King). *Connaught:* Ma'ammee Laogh, Mount Brown Laogh, and Yew Point (J. J. F. X. King). Bath also gives, but without mentioning authorities, near Lanark, Isle of Arran, near Aberdeen, Windermere, and Waterford.

7. Libellula depressa, Linn.

(Plate IV.)

Synonymy.

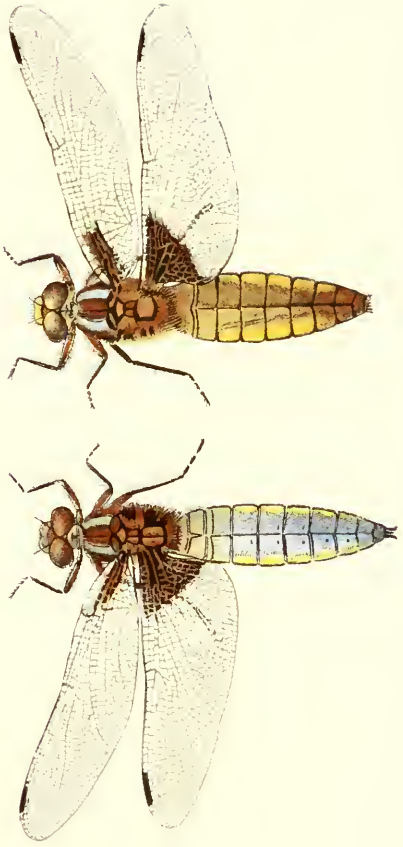
Libellula depressa, Linn. Syst. Nat. 544, n. 5 (1758); Linn. Faun. Suec. 372 (1761); Charp. Lib. Eur. 63, t. 4 (1840); Selys Mon. Lib. Eur. 34 (1840); Selys Rev. Odon. 8 (1850); Hag. Ent. Ann. 40 (1857); Kirby Trans. Zool. Soc. Lond. xii. 284, t. 55, f. 1 (1889); Kirby Syn. Cat. Neur. Odon. 24 (1890). *Platetrum depressum*, McLach. Cat. Brit. Neur. 12 (1870).

Linnæus' description.

L. alis omnibus basi nigricantibus, thorace lineis duabus flavis, abdomine depresso-lanceolato lateribus flavescente. Hæc interdum abdominis tergo cærulescente occurrit. (C. Linnæus, "Systema Naturæ," p. 544, n. 5, 1758.) Descr. *Facies* lutescens. *Thorax* villosus, pallido-virens, antice linea flava. *Alæ* macula marginali atra; et omnes basi nigro-ferrugineæ; intimo margine albo. *Abdomen* lanceolatum, cinereo-virescens, segmentis 3, 4, 5, 6, 7 lateribus luteis; apice obscure ferrugineo; ano setis duabus subularis brevissimis. *Femora* basi livida. *Pedes* nigri. (C. Linnæus, "Fauna Suecica," p. 372, n. 1463, 1761.)

Size.

Length of Male, 47mm.; expanse of wings, 75mm. Length of Female, 42mm. to 44mm.; expanse of wings, 75mm. to 78mm.



Libellula depressa

(nat. size).

Male Imago.

Head, warm dark brown; face and eyes of much the same colour. *Thorax*, dark brown, very hairy, two bluish-yellow longitudinal stripes on the mesonotum. *Legs* black, with the base of the femora brown. *Wings*, hyaline, except for a dark brown patch at the base—oblong on the fore-wings, triangular and of larger size on the hind-wings; the nervures on these patches yellowish; three rows of post-trigonal cells; about 15 ante-cubital nervures, about 12 post-cubital. *Pterostigma*, black, rather narrow, 4mm. long. *Accessory membrane* rather large, white. *Abdomen* broad, much flattened, powdered with bright blue in the adult; yellow lateral spots on segments 3, 4, 5, 6. *Anal appendages* small, black, the superior ones slightly toothed below, and the inferior one very slightly notched at the tip.

Female Imago.

The female differs from the male chiefly in possessing a broader *abdomen* of a tawny colour; the yellow spots are brighter and larger, and are present on the seventh segment, from which they are absent, or nearly so, in the adult male; segments 6, 7, 8, 9 are somewhat strongly outlined in black, and there is a rather distinct mid-dorsal keel; the *anal appendages* are very short. The *face* is of a yellowish-brown, and so lighter than that of the male.

Immature Colouring.

When but lately emerged, in colour the male closely resembles the female. The blue coloration—a kind of bloom which may be rubbed off—does not appear

till the insect has been on the wing for some time, possibly several days.

Variation.

L. depressa is not a variable species. The female, however, occasionally develops the blue coloration on the abdomen, causing her at first sight to resemble the male in general appearance; but a second glance reveals the fact that the shape of the body and the form of the anal appendages are those of the female. No doubt the blue bloom only appears on very old specimens, and is therefore rather a sign of age than of variation. I have myself taken but one blue female, and that was caught in the New Forest on August 2, a late date for this insect. De Selys mentions instances of its occurrence, but says they are very rare.*

Oviposition.

While poised upon the wing the female dips the end of her abdomen and drops her eggs, apparently quite at random, into the water.

Egg.

Pear-shaped, with a little pedicel at the smaller end; size, about ·75mm. long, and ·5mm. broad; colour white, with a pale yellowish tinge; contents, granular. [Extracted from the dead body of a female which contained a large number.] (Fig. 4, No. 3.)

Nymph.

Body sepia-tinted; very hairy; broad and bulky; somewhat flattened; length, including appendages, about

* "Revue des Odonates," p. 9.

25mm.; greatest breadth, 8mm. *Head* of moderate size; somewhat rectangular in shape, the front formed by the mask not being particularly prominent; transverse width about 5·5mm. *Antennæ* seven-jointed, the basal two

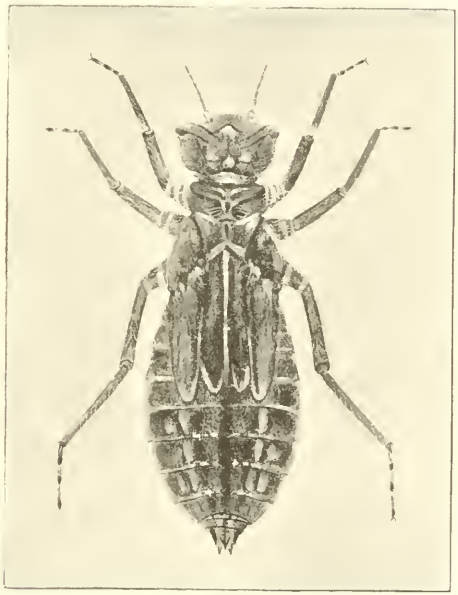


FIG. 25.—NYMPH OF LIBELLULA DEPRESSA.

(Magnified.)

being short and swollen, the distal five slender—of these four and five are rather shorter than the rest, and the seventh is pointed. *Mask* equal in size to that of *L. quadrimaculata*, and closely resembling it in detail. *Eyes* at the lateral corners of the head—very small

spherical knobs, with a prolongation backwards diagonally towards the mid-line of the head. *Top of head* slightly concave. *Vertex* not raised. *Occiput* somewhat rectangular; hind corners much rounded; hind margin nearly straight. *Prothorax* rather broad in centre; margin formed of a raised rim. *Meso-thoracic spiracles* exposed and conspicuous. *Thorax* almost uniform in colour. *Wing-cases* rather broad, about 7mm. long. *Legs* of moderate length, very stout, rather widely separated at their insertion (perhaps formed for burrowing); all parts hairy; coxæ with lighter rings, femora obscurely dark-ringed; length of fore-legs about 12·5mm., of mid-legs 13·5mm., of hind-legs 18mm. *Abdomen* very hairy, brown, with lighter and darker mottlings; sutures light, with a few pale spots dorsally; segments fairly equal except 10, which is small; ninth inclined to be somewhat truncated; on lateral carinæ at the hind corner of each segment a tuft of hairs; on segments 4 to 8 mid-dorsal hairy tubercles pointing backwards. *Anal appendages* rather short, sharp-pointed, hairy; upper and lower about equal, acutely triangular; laterals short, more rounded, dark. [From a bred female, Fig. 25.]

Date.

Quite early in May this Dragonfly appears upon the wing, and if the season is a forward one it may be seen even in the preceding month. April 28 (Surrey, C. A. Briggs) is the earliest date that I have found recorded, while one was seen in Richmond Park as late as August 14, in 1897 (W. J. Ashdown). It is usually at its best in May and June.

Habits.

Perhaps this Dragonfly in as high a degree as any exhibits the propensity for haunting a particular twig. The pursuit of the insect is a somewhat exciting matter, and its capture often requires a considerable amount of perseverance, for though it does not appear to be at all timid, it is nevertheless extremely restless. After allowing one to approach almost within striking distance, it suddenly darts off, usually to return almost directly and probably to the very identical twig it has just left, and this manœuvre it may repeat a large number of times. Patience, however, usually finds the insect a prisoner in the end. Unlike most Dragonflies, *L. depressa* seems to pass a great deal of its time away from the water, and possibly in consequence escapes observation to some extent, for though there is little doubt that the insect is a common one, yet it is seldom that an observer sees very many examples during the season.

Migration.

Dr. Hagen mentions a large swarm of these Dragonflies which passed over Königsburg in June, 1852, and says that they formed a compact band, 60ft. wide and about 10ft. deep, and that moving with the speed of a horse at an easy trot they occupied from nine in the morning till evening in passage, and even then the rear of the column rested in Königsburg till the morning, when they followed their predecessors. The Abbé Chappe, who went to Siberia, in 1761 to observe the transit of Venus, records that whilst at Tobolsk a swarm

of Dragonflies (taken to be of this species) passed over the place, and he estimated that it consisted of a column five leagues long and five hundred ells broad.

Distribution.

De Selys says that this Dragonfly is found in all three parts of the British Isles—"Elle se trouve dans les trois parties des îles Britanniques";* but I have no records for it in Scotland or Ireland, nor in England north of Chester. Perhaps this paucity of recorded localities is due to the fact that the insect is looked upon as common, and therefore to make known its occurrence is unnecessary. The following are all the localities that I have at present been able to obtain:

Cheshire: Chester District (J. Arkle). *Carnarvonshire:* Near Abersoch (J. Arkle). *N. Wales:* Plentiful at pools on coast (J. Arkle). *Worcestershire:* Worcester (J. E. Fletcher); Trench Woods (R. C. Bradley). *Warwickshire:* Earlswood (A. D. Imms). *Gloucestershire:* Cotswolds (R. C. Bradley). *Hampshire:* New Forest (W. J. L.); Pamber, near Basingstoke (A. H. Hamm). *Devonshire:* Lynmouth (C. A. Briggs). *Cornwall:* Land's End (A. Ficklin). *Cambridgeshire:* Littleport (C. A. Briggs). *Essex:* Near Epping (H. Doubleday); Wanstead Park (F. A. Walker); Maldon (E. A. Fitch); Colchester (W. H. Harwood). *Berkshire:* Reading (J. E. Tarbat). *Middlesex:* Northwood, Kingsbury, Cricklewood, and Dudden Hill (F. A. Walker); Burnt Ash Lane (R. McLachlan); Perivale (G. Nicholson); Belmont and Canons Wood Park (F. A. Walker). *Kent:* Deal and

SLD·100·

* "Revue des Odonates," p. 8.



Libellula quadrimaculata

(nat. size).

1, 2, 3, from Surrey Specimens; 4, Scotch.

Dover District (C. G. Hall); Folkestone (G. T. Porritt), *Surrey:* Thames Ditton, Esher, Oxshott, Claygate, Send and Longcross (W. J. L.); Ockham Common and Bookham (C. A. Briggs); Ranmore Common (H. J. Turner); Richmond Park and Horsley (W. J. Ashdown). *Sussex:* Hailsham (G. T. Porritt); common in the woods and lanes in East Sussex (G. T. Porritt).

8.—Libellula quadrimaculata, Linn.

(Plate V.)

Synonymy.

Libellula quadrimaculata, Linn. Syst. Nat. i. 543, n. 1 (1758); Linn. Faun. Suec. 371 (1761); Charp. Lib. Eur. 60, t. 3 (1840); Selys Mon. Lib. Eur. 32 (1840); Evans Brit. Lib. 25, pl. 17, f. 1 (1845); Selys Rev. Odon. 7 (1850); Hag. Ent. Ann. 40 (1857); Packard Amer. Nat. i. 310, t. 9, f. 2 (1867); McLach. Cat. Brit. Neur. 12 (1870). *Leptetrum quadrimaculatum*, Kirby Syn. Cat. Neur. Odon. 27 (1890). *Lib. quadripunctata*, Fabr. Spec. Ins. i. 520, n. 4 (1781). *Lib. maculata*, Harr. Expos. Eng. Ins. 155, t. 46, f. 1 (1782). *Lib. præmubila*, Newm. Ent. Mag. 420 (var.) (1833); Steph. Illustr. Brit. Ent. Mand. vi. 92 (1836); Evans Brit. Lib. 26, pl. 17, f. 2 (1845). *Lib. ternaria*, Say Journ. Acad. Phil. viii., 21, n. 7 (1839).

Linnæus' description.

L. alis posticis basi omnibusque medio antico macula nigricante (C. Linnæus, "Systema Naturæ," i. 543, n. 1,

1758). . . . DESCR. *Thorax* crassus maculis duabus flavis, præter anticam distinctis nigris lineis, a tergo hirsutis. *Abdomen* attenuatum ex lato principio. *Alæ* albæ, versus basin luteæ, sed *inferiores* infra luteum colorem nigræ. *Abdominis* latera et dorsum flavescentia; *cauda* duabus appendiculis teretibus utrinque attenuatis. Nota essentialis, qua hæc species ab omnibus distinguitur, constitit in puncto marginali, quod ut in reliquis versus extremitates nigrum est, sed præter hoc punctum, fusca s. nigra alia macula ad marginem anteriorem, in medio alæ singulæ; adeoque puncta quasi duo marginalia in omni ala. *Oculi* postice subtus linea flava. (C. Linnæus, "Fauna Suecica," p. 371, 1761.)

Size.

Length of Male, 39mm. to 47mm.; expanse of wings, 67mm. to 74mm. Length of Female, 41mm. to 47mm.; expanse of wings, 70mm. to 80mm.

Male Imago.

Head brown; face whitish-yellow, middle of labium and edge of labrum black; eyes brownish. *Thorax* brown, with two broad yellow, irregular lateral bands bounded with black; hairy dorsal projections, yellowish. *Legs* black. *Wings* hyaline, tinged with yellow towards the base; between the base and the anal angle of the hind-wings a triangular dark brown patch with yellow nervures; at the node of all the wings a black spot, from which the insect obtains its specific name; in general four rows of post-trigonal cells; about seventeen ante-cubital nervures on fore-wings, twelve on hind-wings, about twelve post-cubitals. *Pterostigma* black, rather narrow, length 4mm. *Accessory membrane* rather small,

white. *Abdomen* hairy, rather elongate, tapering posteriorly, bright brown; first segment black, 2 to 5 with posterior margin black, 6 mostly black, 7 to 10 black; narrow lateral yellow spots on segments 3 to 8, on the last two very small. *Anal appendages* black; superior long, round; inferior about half the length of superior, triangular, slightly bifid at the tip.

Female Imago.

Closely resembling male, but *abdomen* is shorter and broader; yellow lateral spots larger, and extending to the ninth segment; eleventh segment brownish. *Anal appendages* black, fairly long, spindle-shaped.

Immature Colouring.

When newly disclosed, the insect is of a pale, dingy yellow colour, but in about twenty-four hours the mature tints are assumed.

Variation.

L. quadrimaculata is perhaps the most variable of British Dragonflies. (1) In the first place there is a wide range in size. (2) In what must, from Linnæus' description, be looked upon as the type, there is a saffron tinge at the base of the wings. This, especially in South of England specimens, is often much developed in size and intensity, till it may extend as a broad band almost the whole length of the wings from base to tip, giving a very fine appearance to the insect (Plate V). (3) Less often in the neighbourhood of the pterostigma, and sometimes also of the nodal spots, there is a more or less extended blackish-brown suffusion,

producing the striking form named by Newman, *præmbila*. Usually this form of variation is accompanied by a saffron suffusion also, in which case the colouring of the wings is very rich and beautiful. It is seldom that specimens are taken in the South of England that are altogether free from indications of the last two forms of variation (Plate V). (4) It is said that occasionally the nodal spots are absent, but such an instance has not come under the author's notice. Such a variety might be confused with *L. depressa* (male) or *L. fulva* (male); but the former possesses a dark patch at the base of the fore-wings, and the latter two dark lines, while *L. quadrimaculata* has neither.

Oviposition.

Poised upon the wing, the female drops her eggs apparently quite aimlessly, into the water.

Egg.

Colour white, with a pale yellowish tinge; they become darker—yellowish-brown—after being in water for a short time. Contents, granulated. Shape, nearly elliptical, but slightly oval, with a little pedicel at one end, usually, if not always, the smaller end. Size, about $\frac{3}{5}$mm. in length, perhaps a little under; rather less than $\frac{1}{2}$mm. in width. The specimens described were taken from the body of a dead female, which contained a large number. They closely resemble those of *L. depressa*, but are apparently a little smaller and less pear-shaped.

Nymph.

Body sepia-tinted, hairy, broad, and sturdy; somewhat arched dorsally; length, including appendages, 26mm.,

greatest breadth, 8mm. Head of moderate size, roughly pentagonal, transverse width about 6mm.; rather long from front to back, owing to the extent of mask protruding (Fig. 26). *Antennæ* seven-jointed, the basal two being short and swollen, the rest slender; of these joints 4 and 5 are short, and 7 is pointed. *Mask* reaching to between the insertion of the fore- and mid-legs, narrow at hinge, deeply spoon-shaped, and covering the face; middle lobe and the two palpi meeting at a

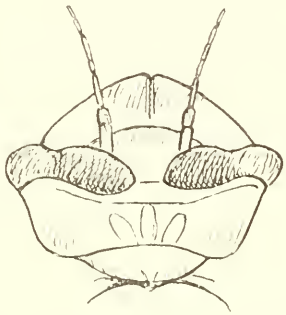


Fig. 26.—Head of Nymph of Libellula quadrimaculata.
(Much magnified; hairs omitted.)

point in the front of the head; palpi triangular, serrated where they approach in the mid-line, and hairy along the outer margin; two half circles of hairs on the body of the mask on the upper surface behind the insertion of the palpi; front border of mask produced in a rather obtuse angle. *Eyes* at the lateral corners of head small, rounded, with a prolongation almost perpendicularly backwards towards the mid-line of the head. *Top of head* convex. *Vertex* somewhat raised. *Occiput* rather narrow in centre, nearly rectangular, hairy; hind margin

nearly straight. *Prothorax* rather broad in centre; hind margin formed by a hairy, raised rim. *Meso-thoracic spiracles* exposed, dark. *Thorax* almost uniform in colour. *Wing-cases* about 7mm. long. *Legs* of moderate length, stout, rather widely separated at their insertion, hairy, especially the tibiæ; distal joint of tarsi dark; length of fore-legs 12mm., mid- 14mm., hind- 19mm. *Abdomen* of a nearly uniform brown tint above, yellowish-white below; segments fairly equal, except 10, which is very small; hind margin of 9 *not* truncated but sloping off gradually to 10; very short lateral spines on segments 8 and 9; sharp, curved, mid-dorsal spines pointing backwards on segments 4 to 8. Anal appendages rather short, sharp-pointed, hairy; upper and lower acutely triangular, about equal; laterals shorter and rounder. The nymph of *L. quadrimaculata* bears a strong resemblance to that of *L. depressa;* it is, however, less hairy; the legs are perhaps a little more slender; the mid-dorsal tubercles of the latter species are replaced by spines, and there are some differences in the head, especially in the direction of the eyes. [From Surrey specimens.]

Emergence of Imago.

The emergence here described was watched on June 1, 1898. At 12.52 the insect had just commenced to appear, the head and thorax were out, but not the legs; by 12.54 the fore-legs were out, and the body was hanging back, head downwards; at 12.55 the mid-legs were out; and by 1.2 the hind ones had followed. In this apparently uncomfortable position now followed a lengthy rest, during which the legs were occasionally

pressed close to the body, while a strong shudder passed through it. The wings at the basal part of the costal region had begun to swell out considerably before the resting period was over. At 1.54, the insect, without any warning, suddenly swung itself upwards, took hold of the nymph-case, and drew out the rest of its abdomen. Neither wings nor abdomen at first expanded very rapidly, and at this period of the expansion of the wings there was not much movement, except that the insect shook itself a little backwards and forwards. At 2.12 the wings were the length of the body (which had not yet increased much in length), and they now seemed to be growing much faster. The insect was also swaying itself from back to front continuously, and, as the wings were approaching full size, more rapidly and strongly. At 2.17 the wings were nearly or quite $\frac{1}{2}$in. longer than the body. At times the swaying ceased, while the end of the abdomen moved forward; then it contracted, and it appeared that something was being forced into the wings, but the Dragonfly did not walk forward along its support. At 2.26, though a little wrinkled along the hind margin, the wings, which were yellowish-white and opaque, appeared to be nearly of full length, and reached about $\frac{3}{4}$in. beyond the extremity of the abdomen, which had thus far not much increased in length. At 2.35, though still opaque, the wings seemed to be fully developed and extended nearly 1in. beyond the tip of the body. Swayings of the abdomen still occurred at times, but they appeared to be nearly over. The wings were still held as in the resting position of the *Agrionidæ*, with their upper surfaces

towards one another, but in the evening they were spread out, and the spots and pterostigma were dark; the body, too, had reached its full length, and the segments at the tip had assumed their dark colour. By the following evening, though the wings were still glossy, the insect had practically assumed its mature colouring. This nymph, which produced a female, was probably one of two that had been waiting at the surface of the water for more than a day beforehand. Another, a male, emerged on June 2.

Date.

In the forward spring of 1894 this Dragonfly was taken on Esher Common as early as April 25, but in normal years it does not appear till the beginning of May. It continues on the wing till the end of July or beginning of August, my latest capture having been made on the 7th of the latter month, though in 1895, in Surrey, I tried to catch a Dragonfly, which appeared to belong to this species, as late as September 9.

Habits.

Libellula quadrimaculata seems to have a liking for boggy pools, and perhaps prefers those situated in fir-woods. In general its flight is rapid, though of short duration; but as it seems to be very watchful when settled, the insect is not an easy one to capture. It may sometimes be taken at rest late in the afternoon (for it retires early) on the heather, where it may possibly be betrayed by its wings, though perhaps not often in such a striking manner as once fell under the

observation of Mr. Arkle, in Delamere Forest, who, in the *Entomologist*, p. 35, 1898, says: "There they were at varying intervals, with their wings spread out and glistening, for all the world like distant windows in the setting sun. Far away for a long distance on the heath I could easily make them out."

Migration.

As a wanderer this Dragonfly is well known, and to this habit is due perhaps the fact that it circles the globe in the cooler zones of the Northern Hemisphere. Many European migrations have been recorded.

A tremendous swarm passed over Malmö, in Sweden, in June, 1883;* a large one was observed off the Essex coast in June, 1888;† while a smaller one visited Dover in June, 1889.‡ The account of the first-mentioned flight, as recorded in *Nature*, is here reproduced: "On Sunday, June 24, we had an extraordinary flight of the *Trollslända* (*Libellula quadrimaculata*, Linn.) a brown Dragonfly, 1⅝in. long and 3in. from tip to tip of the wings. They passed over or through the town and neighbourhood for about half an hour in the afternoon. The next day, about one o'clock, they reappeared for more than an hour; but on Tuesday, the 26th, at 7.30 a.m., they again began in millions, and notwithstanding the wind had shifted to the South during the night, they held the same course from North-West by West, heading South-East by East. The streets, shipping, and every place were full of

* *Nature*, July 19th, 1883. Vol. xxviii., p. 271. † J. Cordeaux. E. M. M., 1888, p. 93. ‡ C. G. Hall in E. M. M., 1889, p. 324.

them. They did not fly very high, and seemed to avoid going into open doors and windows. Some hundreds or so alighted on the gooseberry bushes, apple, and pear trees in the garden, but never touched the fruit. [An almost unnecessary observation, seeing that all Dragonflies are animal feeders!] I observed one sitting on the dead tip of an apple-twig, and I pushed it off with my stick *thirteen* times, the insect returning each time after flying away about five or six yards The flight ended that night about 8 p.m., having been incessant for more than twelve hours. On the 27th they appeared again about noon, flying the same course, but in much reduced forces. Each day since I have seen a few, but very few The papers say they were observed in all Southern and Central Sweden, and in many places in Denmark, and they swarmed about the ships in the Sound. With their disappearance came the hot weather." One is lost in conjecture as to the position of the sheets of water in which so large a number of insects could have been nurtured, and as to the host of small creatures, many times as numerous as themselves, that they must have destroyed in reaching maturity.

In 1888, Mr. S. Pender, master of the "Swin Middle" Light-vessel, off the Essex coast, reported that on June 23, from 6 to 8 p.m., a flock of Dragonflies, which proved to be *L. quadrimaculata*, came on board and rested on the ropes and even on the cable the vessel was moored with, from the bows down close to the water's edge. The wind was E. by S., and the weather fair and clear. . . . In 1889, Mr. H. Gatke, writing from Heligoland, said that on May 21 and 22, *Libellula*

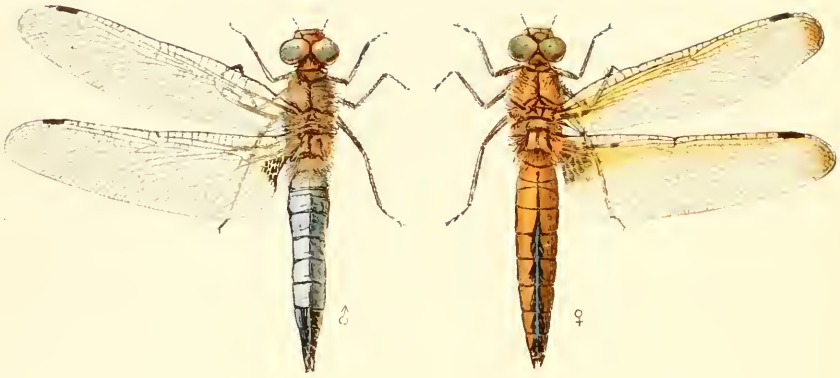
quadripunctata swarmed there by the million and continued to the 26th, when the wind became northerly, and next morning not a single one was to be seen.* On June 6 in the same year, Mr. Hall, of Dover, reported a flight of some hundreds of Dragonflies of this species (possibly belonging to the flight last mentioned) which took place at Dover. They were flying round the middle of the Admiralty Pier, and were not observed in the town. Mr. Hall states that he had witnessed extraordinary flights of this species in France, similar to the swarms observed at Malmö, in 1883, but that the one at Dover was small. The weather was dull and oppressively hot, with a slight wind from the N.E., and the Dragonflies appeared to have come up with the storm-clouds in a south-westerly direction. Hundreds were seen the next day, notwithstanding a storm on the evening of the 6th, and a few on the 8th. Some were var. *præmubila*, and in one the sub-costal veins between the base and the cubital spot, were slightly tinged with orange. Such are instances of migrations that have been recorded in the English magazines. It is reported that a great migration occurs almost every year from north to south in the Charente Inférieure in France.

Distribution.

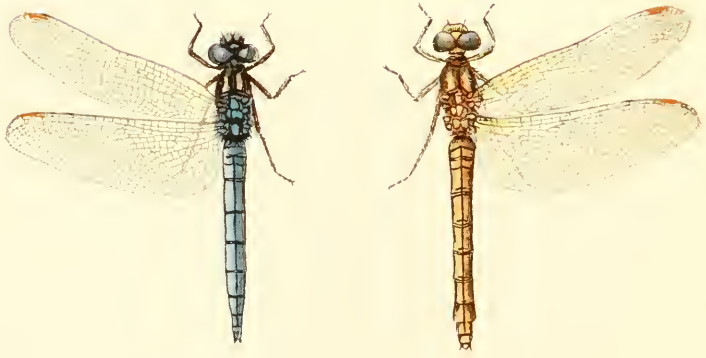
Though considered a local insect, *Libellula quadrimaculata* is well distributed throughout the British Isles, and where it occurs is generally common. Localities are: *Inverness-shire:* Strathglass, Glencannich, and Insh

* Entom., 1889, p. 189.

(J. J. F. X. King). *Argyllshire:* Tobermory and Ledaig (J. J. F. X. King). *Perthshire:* Rannoch (J. J. F. X. King). *Lanarkshire:* Glen Lockay (K. J. Morton). *Westmoreland:* Loughrigg Fell (J. J. F. X. King). *Lancashire:* North (J. Arkle). *Yorkshire:* Thorne Moor (G. T. Porritt). *Cheshire:* Delamere Forest (J. Arkle). *Warwickshire;* Earlswood and Hockley Heath (A. D. Imms). *Worcestershire:* Worcester (J. E. Fletcher). *North Wales:* (J. Arkle). *Carnarvonshire:* (J. Arkle). *Monmouthshire:* Abergavenny (R. C. Bradley). *Cornwall:* Land's End (A. Ficklin). *Devonshire:* Lynmouth (C. A. Briggs). *Dorsetshire:* Studland (J. E. Tarbat). *Hampshire:* Lyndhurst (R. McLachlan); Brockenhurst (W. J. L.). *Berkshire:* Dry Sandford (M. Burr); Reading (J. E. Tarbat); Bulmershe Park (A. H. Hamm). *Middlesex:* Burnt Ash Lane (R. McLachlan). *Surrey:* Esher Common, Byfleet, Ockham Common, Chobham Common (W. J. L.); Weybridge (J. E. Tarbat). *Sussex:* East (G. T. Porritt); Hailsham (G. T. Porritt); near Liphook (W. J. L.). *Kent:* Kingsdown (C. G. Hall); Dover (G. T. Porritt). *Essex:* Epping (H. Doubleday); Colchester and Clacton-on-Sea (W. H. Harwood). *Cambridgeshire:* Knarr Fen (K. J. Morton); Wicken Fen (W. J. Ashdown). *Norfolk:* Broads, near Lowestoft (J. Prest). *Ulster:* Glasslough, Co. Monaghan (K. J. Morton); Churchill and Armagh (J. J. F. X. King). *Leinster:* Twy Laogh (J. J. F. X. King). *Munster:* Skibbereen, Co. Cork (J. J. Woolfe); Ross Castle (J. J. F. X. King). *Connaught:* Carrowbeg River and Mackree Castle (J. J. F. X. King). *Guernsey:* S. Peter Port Harbour (W. A. Luff).



Libellula fulva
(nat. size).



Orthetrum cærulescens
(nat. size).

9. Libellula fulva, Müll.

(Plate VI.)

Synonymy.

Lib. fulva, Müll. Faun. Ins. Fridr. 62. n. 544 (1764); Selys Rev. Odon. 9 (1850); Hag. Ent. Ann. 41 (1857); McLach. Cat. Brit. Neur. 12 (1870). *Leptetrum fulvum*, Kirby Syn. Cat. Neur. Odon. 26 (1890). *Lib. fridrichsdalensis*, Müll. Faun. Ins. Fridr. 62, n. 549 (1764). *Lib conspurcata*, Fabr. Ent. Syst. (Suppl.) 283 (1798); Steph Illustr. Brit. Ent., Mand. vi. 91 (1836); Selys Mon. Lib. Eur. 35 (1840); Charp. Lib. Eur. 59, t. 2 (1840); Evans Brit. Lib. 25, pl. 16, f. 3 (1845). *Lib. fugax*, Harr. Expos. Eng. Ins., 156, t. 46, f. 2, 1782). *Lib. quadrifasciata*, Don. Brit. Ins. xii., t. 425 1807). *Lib. bimaculata*, Steph. Illustr. Brit. Ent., Mand. vi. 92 (1836); Evans, Brit. Lib. 26 (1845).

Müller's description.

Libellula fulva, alis basi fulvescentibus macula marginali nigra: thorace abdomineque fulvo. (Müller, "Fauna Insectorum Fridrichsdalina," p. 62, n. 544, 1764.)

Size.

Length of Male, 44mm.; expanse of wings, 74mm. Length of Female, 45mm.; expanse of wings, 73mm.

Male Imago.

Head very dark. *Eyes* ashy-blue. *Thorax* hairy, dark brown in very adult specimens, but lighter in younger ones. *Legs* black, except femora, which are brown

Wings hyaline, with the extreme tip sometimes slightly clouded, one (or two) dark brown lines at the base of the fore-wings, and a similar line and a triangular spot at the base of the hind ones; on these spots the nervures are yellowish; three rows of post-trigonal cells; ante-cubital nervures about 12, post-cubital about 11. *Pterostigma* nearly black, rather narrow, about 3mm. in length. *Accessory membrane* small, rather dark. *Abdomen*, sides nearly parallel in segments 2 to 6, the last four tapering; a distinct dorsal keel; colour light blue, except segments 1 and 2, which are dark, and a black mid-dorsal line, which, starting on segment 7, spreads out posteriorly till it occupies nearly the whole of segment 10; each of the blue segments has two tiny transverse black streaks, one on each side of the mid-dorsal line in the posterior part of the segment. *Anal appendages* as long as the ninth segment, black; upper cylindrical, pointed; lower triangular, a little shorter, turned up at the tip.

Female Imago.

In the female the abdomen is tawny, with the black mid-dorsal markings on more of the segments than in the adult male. The wings are tipped with dark brown. The head and thorax are lighter than in the mature male, and of a yellowish-brown colour, like that of the abdomen.

Immature Colouring.

Apparently the male of this species is very slow in assuming its cerulean tint; till then it very closely resembles the female, which does not change much in

colour as it becomes adult. The male figured in Charpentier's "Libellulinæ Europææ," t. 2, is immature.

Variation.

It was once considered that the suffusion at the tip of the wings was a mark of variation; but though this brown patch certainly varies somewhat in size it must be looked upon as a sexual distinction, it being always, or nearly always, present in the female, and absent, or but very slightly indicated, in the male. As in *L. quadrimaculata*, the wings are sometimes suffused to a greater or less extent with a saffron tint, especially near the costal margin.

Time.

Certainly from June to August, but whether earlier than June is not clear.

Distribution.

Though seldom captured, this species is in all probability generally distributed, but it is rare in the South of England. That it may often escape notice is easily understood, for unless a near view were obtained it would with difficulty be distinguished from *L. depressa*, *Orthetrum cancellatum*, and possibly *O. cærulescens*, and as its capture is not an easy matter, no doubt its resemblance to these insects often does prove its safeguard. Recorded captures may almost be counted on one's fingers. They are: *Kent:* A female at Kingsdown, near Deal, in 1881 (C. G. Hall); a rather worn adult male near Sandwich, on August 22, 1898 W. J. L.. *Suffolk:* A single specimen at

Beccles, in the marshes, in 1892 (C. Morley). *Essex:* A single specimen at Colchester (W. H. Harwood). *Hampshire:* An adult male near Ringwood, not far from the Avon, just outside the New Forest, 1897 (K. J. Morton). *Yorkshire:* Two females at Askern, one of which passed into the possession of Mr. G. T. Porritt, June, 1888 (S. L. Mosley). Doubleday said that it was rare in the neighbourhood of Epping, but was occasionally found flying over a large pond in Ongar Park woods. In addition, Bath mentions several localities, but does not enter into particulars with regard to them—Burwash Fen and Whittlesea Mere in Cambridgeshire; Sprawston, near Norwich, in Norfolk; Marshes near Bermondsey; Parley Heath in Hampshire and Dorset; Glanvilles Wootton in Dorset; Newham in Bedfordshire; Deptford in Kent; and Bishop's Auckland (?) in Durham.

10. Orthetrum cærulescens, Fabr.

(Plate VI.)

Synonymy.

Libellula cærulescens, Fabr. Ent. Syst. Suppl. 285 (1798); Steph. Illustr. Brit. Ent. Mand. vi. 93 (1836); Charp. Lib. Eur. 67, t. 6 (1840); Evans Brit. Lib. 29, pl. 18, f. 2, 3 (1845); Selys Rev. Odon. 22 (1850); Hagen Ent. Ann. 42 (1857). *Orthetrum cærulescens* McLach. Cat. Brit. Neur. 13 (1870); Kirby Syn. Cat. Neur. Odon. 36 (1890). *Lib. vulgata*, Scop. Ent. Carn. 261, n. 680 (1763). *Lib. biguttata*, Don. Brit. Ins. xiii., t. 449 (1808). *Lib. donovanni*,

Leach Edinb. Enc. ix. 136 (1815). *Lib. opalina*, Charp. Hor. Ent. 45 (1825). *Lib. olympia*, Fonsc. Ann. Soc. Ent. France, vi. 139, t. 6, f. 1-2 (1837); Selys Mon. Lib. Eur. 40 (1840); Ramb. Ins. Névr. 67 (1842). *Lib. dubia*, Ramb. Ins. Névr. 67 (1842).

Fabricius' description.

L. alis hyalinis: stigmate marginali fusco, corpore cærulescente Media. Os flavescens fronte nigricante. Corpus cærulescens, immaculatum. Alæ basi immaculatæ. (Fabricius, "Entomologia Systematica," Supplement, p. 285, 1798).

Size.

Length of Male, 41mm. to 43·5mm.; expanse of wings, 59mm. to 62·5mm. Length of Female, 40mm. to 42mm.; expanse of wings, 59·5 to 62mm.

Male Imago.

Head and *face* yellowish-brown, darker on the vertex. *Eyes* dark ashy-blue, in contact but a short distance. *Thorax* very dark brown, slightly powdered with blue behind; two conspicuous pale yellowish-blue dorsal lines, three broad, oblique, lateral, yellow ones; prominences between wings yellow. *Legs* stout, very dark. *Wings* hyaline, costal nervure yellow, about twelve ante-cubital nervures, about ten post-cubitals. *Pterostigma* orange, outlined with a strong black nervure, rather over 3mm. long. *Accessory membrane* small, narrow, whitish. *Abdomen* narrow, somewhat flattened, but with a mid-dorsal keel, powdered with blue, two tiny dorsal black transverse lines on segments 3 to 8 in the posterior

part of the segment. *Anal appendages* black; upper ones cylindrical, pointed, as long as the last segment but one; lower triangular, turned up at the tip.

Female Imago.

Head and *thorax* much the same as the male but lighter, and quite without blue powdering. *Eyes* brown. *Legs* brown. *Wings* suffused with saffron towards the costal margin. *Abdomen* yellowish-brown (in very old specimens dark brown), rounder than in male, dorsal keel and margins of segments dark brown, transverse posterior lines meet in this sex and broaden, forming a black mid-dorsal transverse streak, through which the keel passes. *Anal appendages* cylindrical, pointed, about as long as the tenth segment, pale brown. *Vulvar scale* notched at the tip, the points swollen. Sides of eighth and ninth segments forming a kind of wing below.

Immature Colour.

When immature, the male closely resembles the female in tint. The cerulean bloom appears after a time on the abdomen, and usually spreads more or less over the thorax, the parts not blue becoming darker. The surface of the immature abdomen is glossy.

Variation.

In the British Isles this insect does not seem to vary very much—not even in size. The dark colour of the abdomen of the female and of the wings of both sexes, observed late in the season, are simply due to age. On the Continent blue-bodied females and males with dark pterostigmata have been noticed, these changes also having been caused no doubt by age.

Egg.

Length about half a millimetre; width a little over a quarter of a millimetre; shape more or less elliptical, with a small pedicel at one end; contents granular; colour yellowish-white (Fig. 4, No. 10). The description and figure were taken from a female caught in the New Forest, August, 1897. They were brought home in spirit, and therefore were in most cases much shrivelled.

Date.

O. cærulescens is a mid-summer species. My earliest record for its appearance is June 4, and the latest communicated in September. It would, therefore, be at its best in late June and July.

Habits.

Boggy ground seems to be the favourite haunt of this species. Though swift, its flight is not of long duration. The insect appears and is off again like a flash of lightning, making its capture by no means an easy matter. It will entice its pursuer for a long distance, and often over treacherous ground, settling or hovering for a time, but flying off continually so as to keep well out of the reach of the net; and should it perchance stay too long on the ground, so well does it harmonise with its usual surroundings, that its would-be captor obtains very little assistance from the circumstance.

Distribution.

The records I have been able to obtain of this species do not appear to be representative. The most northerly

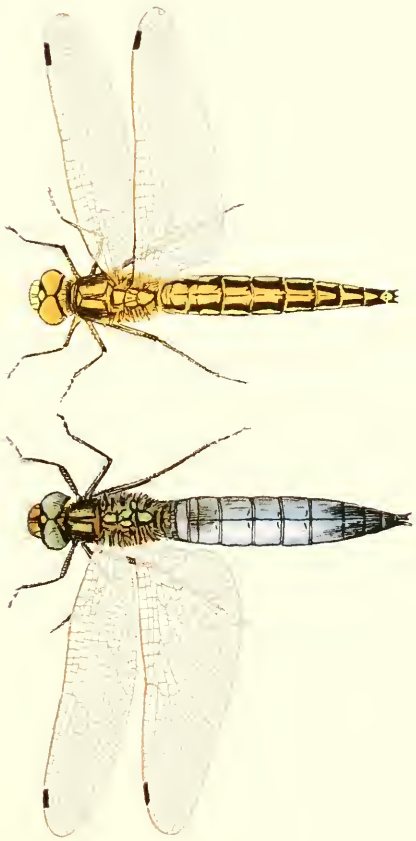
I have is in Cheshire, so that this Dragonfly would seem to be absent from Scotland and the north of England. Recorded localities are: *Cheshire:* Parkgate and Bidston (J. Arkle). *Merionethshire:* near Maentwrog (J. Arkle); Tan-y-bwlch and Barmouth (A. D. Imms). *Cambridgeshire:* Wicken and Chippenham Fen (G. T. Porritt). *Oxfordshire:* Cowley (A. H. Hamm). *Berkshire:* Reading (A. H. Hamm). *Cornwall:* Land's End (A. Ficklin); Bude (C. A. Briggs). *Devonshire:* Bovey Tracey (A. H. Hamm). *Dorsetshire:* Studland (J. E. Tarbat). *Hampshire:* New Forest, common (W. J. L.). *Surrey:* Weybridge (J. F. Stephens, 1842); Bisley (A. Ficklin, jun.). *Kent:* Chattenden (H. J. Turner). *Guernsey:* Grande Mare (W. A. Luff). *Munster:* Dinish and Gap of Dunloe (J. J. F. X. King). Bath mentions—near Godalming; Charmouth; Portland; Empole; Parley Heath; Emborne; Gamlingay Bog, Isle of Man; Blackgang Chine, Isle of Wight; near Bodmin; Falmouth ("Handbook," p. 39).

11. Orthetrum cancellatum.

(Plate VII.)

Synonymy.

Libellula cancellata, Linn. Syst. Nat. i. 544, n. 7 (1758); Faun. Suec. 373, n. 1465 (1761); Don. Brit. Ins. xiv. 472 (1810); Steph. Illustr. Brit. Ent. Mand. vi. 93 (1836); Evans Brit. Lib. 26, pl. 17, f. 3,



Orthetrum cancellatum

(nat. size).

pl. 18, f. 1 (1845); Charp. Lib. Eur. 65, pl. 5 (1840); Selys Mon. Lib. Eur. 37 (1840); Selys, Rev. Odon. 12 (1850); Hag. Ent. Ann. 41 (1857). *Orthetrum cancellatum*, McLach. Cat. Brit. Neur. 13 (1870); Kirby Syn. Cat. Neur. Odon. 38 (1890). *Lib. frumenti*, Müll. Faun. Fridr. 62, n. 551 (1764). *Lib. lineolata*, Charp. Hor. Ent. 44 (1825).

Linnæus' description.

L. alis basi immaculatis, abdomine dorso lateribusque interrupte luteis. (C. Linnæus, "Systema Naturæ," i. 544, n. 7, 1758.) DESCR. Facies pallida, fronte nigra. Oculi postice linea flava nigro interrupta. *Thorax* antice testaceus lineis duabus nigris et lateribus maculis duabus flavis. *Abdomen* dorso flavum utrinque lineis duabus nigris longitudinalibus et segmentorum marginibus nigris. (C. Linnæus, "Fauna Suecica," p. 373, n. 1465, 1761).

Size.

Length of Male, 48·5mm. to 52·5mm.; expanse of wings, 76mm. to 83mm. Length of Female, 49mm.; expanse of wings, 77mm.

Male Imago.

Head dark, face paler, eyes blue. *Thorax* yellowish-brown, with a lateral black line on each side of meso-notum; meso- and meta-pleura yellowish, separated by a black line. *Legs* black, with the base of the femora brown. *Wings* large, hyaline, about fourteen ante-cubital nervures and nine post-cubital. *Pterostigma* narrow, 2·5mm. long on fore-wings, 3mm. on hind-wings, black. *Accessory membrane* rather long, narrow,

grey. *Abdomen* rather long, flattened behind the third segment, powdered with blue except segments 1, 2, 8, 9, 10, which are black, and the 7th, which is partly so; there is a fine mid-dorsal black line as well as a pair of dorsal, transverse, tiny black streaks near the posterior edge of the blue segments. Upper *anal appendages* cylindrical, about 2·5mm. long, black; lower one shorter, triangular, dark, turned up at tip.

Female Imago.

Face yellow. *Thorax* yellow, dorsal prominences and markings edged with black *Abdomen* yellow, each segment edged with black, two broad dorsal black lines extending along its whole length. *Anal appendages* short, black. *Pterostigma* narrow, 3mm. long, black. *Vulvar scale* not prominent, with a deep rounded notch. Borders of ninth segment winged below.

Immature Colouring.

Till the blue powdering appears, the male is exactly like the female in colour.

Variation.

This species does not seem to be subject to much variation. Bath mentions that the lateral black line of the female is occasionally very broad.

Nymph.

In *Science Gossip*, July, 1894, Mr. W. H. Nunney gives a figure of the nymph, and says that: "An old writer, Muraldt, published in a now rare Latin work, entitled 'Ephemeris Naturæ Curiosorum,' a loose

general description illustrated by a rude engraving. The colour is wholly cinereous; the eyes are prominent and of a clear bright green; the antennæ are short, thick, and pilose; on both sides of the head beneath the eyes are hairs; and the mouth is also pilose. The abdomen is broad, tapering towards the point, which is pilose, and is hairy at the sides. Several blackish transverse lines ornament the head, and the abdomen is distinctly marked along the sides with blackish spots. There are also some spots in front, and two lines on the tarsi. The mask is two-thirds the length of the head."

Date.

In 1896 a specimen was taken in Surrey, on May 17, while the latest record for the species appears to be in July; but information is not sufficient for any definite statement to be made with regard to the limits of its period of flight.

Habits.

Besides frequenting marshy spots, this species seems to have a liking for brick-holes, gravel-pits, and such localities. From its great resemblance on the wing in appearance and habits to *Libellula depressa*, it may, perhaps, be sometimes passed over for that insect.

Distribution.

McLachlan says* it is possibly confined to the southern half of England, but that it is often common about brick-holes in the London district. The small

* E. M. M., p. 253, 1884.

number of instances and records that have come under my notice are: *Middlesex:* Lee clay-pits by Burnt Ash Lane (R. McLachlan). *Surrey:* Ockham Common (C. A. Briggs); a brick-field at Merton (J. S. Brocklesby); near a brick-field, New Malden (W. J. L.); near Byfleet (F. A. Walker).* *Sussex:* Near Liphook (W. J. L.). On July 26, 1896, I for a long time watched in Richmond Park, but could not capture what, from the black appearance of the extremity of its abdomen, appeared to be a male of this species. Evans (1845), on Stephens' authority, says this species is found in Kent. Bath† gives as localities without mentioning authorities: Croydon canal; marshes near Crayford and Dartford; Horning and Fakenham in Norfolk; Whittlesea Mere; Abbey Meadows, Kilburn; Peckham; Oak of Honour Wood.

12. Somatochlora metallica, Lind.

(PLATE VIII.)

Synonymy.

Libellula metallica, Lind. Mon. Lib. Eur. 18 (1825); Charp. Lib. Eur. 94, t. 15 (1840). *Æschna metallica*, Charp. Hor. Ent. 59 (1825). *Cordulia metallica*, Steph. Illustr. Brit. Ent. Mand. vi. 89 (1836); Selys Mon. Lib. Eur. 64 (1840); (?) Evans Brit. Lib. 24, pl. 15, f. 1 (1845); Selys Rev. Odon. 69 (1850); Hag. Ent. Ann. 47 (1857). *Epitheca metallica*, Selys Bull. Acad. Belg.

*Identified by description only. †"Handbook," p. 40.



Somatochlora metallica
(nat. size).



Somatochlora arctica
(nat. size).

(2) xxxi. 288 (1871). *Somatochlora metallica*, Kirby Syn. Cat. Neur. Odon. 48 (1890). *Lib. ænea*, Panz. Ins. Deutschl. Heft. 88, t. 20 (1805); [? ? *ænea*, Har. Expos. Eng. Ins. 92., t. xxvii., f. 2 (1782)].

Vander Linden's description.

L. viridi-ænea, abdominis medio incrassato, appendicibus analibus omnibus maris simplicibus, acuminatis; alis lutescentibus, macula marginali lutea. . . . Mas. Caput æneum, fascia frontali arcuata, labii superioris basi, inferiori toto, luteis. Oculi virides, suprà rufescentes. Thorax æneus rufo-tomentosus. Abdomen æneum: secundi segmenti angulis posticis subtùs latè productis: ejusdem margine postico, puncto utrinque, et striga laterali, tertii autem macula utrinque laterali baseos, luteis. Appendices anales acutæ: superiores tenues, basi ab invicem remotæ, externe sinuatæ, longitudine duorum ultimorum segmentorum abdominis: inferior, brevior, crassior, triangularis. Pedes nigri, femoribus anticis basi luteis. Alæ lutescentes, callis nigris luteo maculatis, macula marginali lutea, membranula accessoria albida, posticarum magna, ad marginem internum cinerea. . . . Femina. Hujus primum et secundum abdominis segmentum, margine postico et laterali, punctoque utrinque luteis: cætera immaculata. Antepenultimum autem subtùs et posticè in appendicem concavo-acuminatam, productum. Appendices anales duobus ultimis segmentis abdominis longiores Caput, thorax, alæ, pedes ut in mare. . . . Longit. 22-23 lin. Extens. alar. 34 lin. (P. L. Vander Linden, "Monographiæ Libellulinarum Europæarum Specimen," p. 18, 1825).

Size.

Length of Male, 52·5mm.; expanse of wings, 77mm. Length of Female, 56mm.; expanse of wings, 82mm. [From a pair of continental specimens.]

Male Imago.

Head bronze-green, lower edge of frons and also the rhinarium and labium yellow. *Eyes* bronze-green. *Prothorax* bronze-green, marked with yellow. *Thorax*

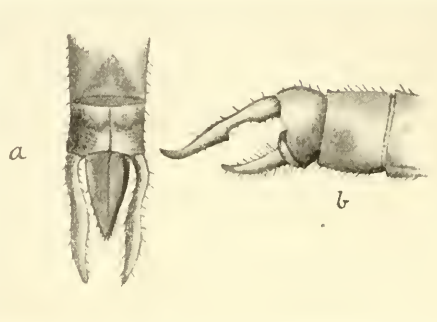


Fig. 27.—Anal Appendages of Male of Somatochlora metallica. (Magnified.)
a., Dorsal view. *b.*, Lateral view.

bronze-green, covered with russet down; attachments of wings and projections between them brownish-yellow. *Wings* with slight saffron tint; anal angle of hind ones pointed. *Pterostigma* not quite 3mm. long, dark brown, paler when immature, between black nervures. *Accessory membrane* long and rather dark, but white at base. *Legs* black. *Abdomen* bronze-green, swollen at second segment, contracted at third, then swelling out, and again contracting somewhat towards the end; on

each of segments 2 and 3 are two small yellow spots on the dorsal surface, and larger ones below; the suture between the same segments is also yellow. *Anal appendages* long, black; the shape of the upper ones will best be seen from Fig. 27; they are rounded above, but have two projections below; the lower is triangular, and considerably shorter than the upper ones.

Female Imago.

On the upper surface the eyes have a chestnut tint. *Wings* tinged with saffron, especially in the costal region; anal angle of hind-wings rounded. *Pterostigma* dark brown, between black nervures; on the hind-wings it is rather longer than on the fore, being 3mm. in length. *Abdomen* swollen at second segment, afterwards contracted but little. *Anal appendages* long and slender. *Vulvar scale* as long as ninth segment, pointed like a bird's lower beak and standing out at right angles to the body. In other respects female resembles male.

Variation.

The wings vary in the depth of the saffron tint, which is usually but little in evidence in the male. According to Charpentier the spots on segments 2 and 3 of the abdomen are not constant in size in the female, and may even be absent altogether.

Egg.

Length about ·5mm., width from about half to two-thirds of length; shape elliptical; of a very pale yellowish tint; contents in appearance granular; a rather long, slender, transparent pedicel at one end, which appears

to belong to a thin transparent outer layer. [Eggs removed from outside the vulvar scale of a worn female captured at Strathglass, while apparently ovipositing (C. A. Briggs, *in litt.* 13. vii. 99)].

Nymph.

Mr. L. Cabot describes the nymph of *S. metallica* in the following terms: "Length, 24mm.; breadth, 9mm. Body oblong, enlarged and truncate behind, about naked; head short, narrower than abdomen, half as long as broad, slightly rounded in front, straight behind; sides projecting; conical eyes, slightly prominent; behind the eyes an undulating transverse crest, making on each side of vertex a light curve, a little elevated, with a comb of fine bristles; forehead about flat, vertex small, rounded, ocelli not indicated; front margin slightly rounded, with a fringe of long cilia; occiput in middle with two small conical tubercles, and on each side near the margin with a bunch of half-a-dozen long, thick hairs; antennæ long exceeding the lower margin of palpus; basal joints a little thicker; first longer than broad; second longer than first; third not quite as long as the two basals together; fourth half the length of third; fifth to seventh equal, each a little shorter than third; seventh subuliform, sharp. Mask extending between front legs spoon-shaped, as long as broad; basal part four times broader in front than at base; front border triangularly produced, obtuse-angular; palpus large, triangular, edge straight, with about nine interlocking teeth; movable hook short, straight, sharp. Prothorax short, narrower than head, slightly rounded behind; middle third of the

hind border with a strongly inflated rim, ending abruptly on both ends; sides a small elliptical lobe, bent upwards; stigmata free; wing-cases reaching half of sixth segment; abdomen once longer than broad, oblong, roof-shaped, segments 8 and 9 sloping, the last truncate; segments of equal length; the tenth very short, entirely inserted in the rounded apical notch of ninth; lateral spines on eighth and ninth flat, short, sharp; a little longer, the tip bent inwardly, on ninth; dorsal hooks on third to ninth spine-like, the last three strong, long, bent at tip; anal appendages short, as long as the last two segments, thick at base, pyramidal, not sharp at tip; dorsal median flat above, as long as inferiors; laterals a little shorter, strong, tip abruptly sharpened; longitudinal ventral sutures straight, ending inside of apical tip of segment 9; space between them broader than lateral spaces; basal angle of segments 3 to 5 separated triangularly by an elevated ridge; ventral apical border of ninth segment with a long fringe of hairs. Legs widely separated, fore legs a little less, long, strong; femur a little incurved, of hind legs reaching middle of seventh segment; tibia straight, of the four hind legs fringed with long hairs; tarsus long, first joint of hind legs little shorter than second; claws strong, a little incurved, sharp; genitals marked; ventral bag on sixth segment. Around the dorsal hooks a round pale spot; on each side an ill-defined darker spot and two black dots on each side; scars oval, dark; femora and tibiæ with two blackish rings." (L. Cabot, "The Immature State of the Odonata," Part III. Memoirs of the Museum of Comparative Zoology at Harvard College, U.S.A., 1890.)

Date.

At Strathglass this Dragonfly was found on the wing in July and August. In Belgium, according to De Selys, it occurs as early as the middle of May.

Habits.

"*S. metallica* was found, from hints given to me by the late Dr. Buchanan White, at a mountain loch in Strathglass. I spent over a fortnight in search of it every day, but although I saw many specimens, I found it very difficult to capture, as it has a habit of hovering and flying well over the surface of the loch away from the edges. At times the males gave a large sweep round, at which time it was the collector's opportunity of netting the beautiful creature. I only saw one female, and this I captured *in copula* with a male. Copulation took place over the water, and then the pair made for the side, but my net was in the way, and now they both grace my cabinet. About five miles from the above locality I captured a male flying in a ditch in a wood otwards the middle of August. This specimen was somewhat faded." (J. J. F. X. King, *in litt.*)

Distribution.

This insect had for a long time been on the British list in consequence chiefly, if not entirely, of Harris' very uncertain figure in his "Exposition of British Insects," which figure too he himself names *ænea*, and which is probably intended for that insect. In 1869, however, Dr. Buchanan White captured some Dragonflies, which he found not rare, about some of the lochs in Strathglass, in Inverness-shire. He took them to be

S. arctica, and sent them to Mr. McLachlan as such; but they turned out to be *S. metallica*, which thus obtained an unequivocal footing amongst the British fauna. In 1880, after much hard work, a few more specimens were obtained in the same locality by Mr. King, of Glasgow, who must be looked upon as the only living entomologist who had taken this species in the British Isles till this year, 1899.

13. Somatochlora arctica, *Zett.*

(Plate VIII.)

Synonymy.

Æschna arctica, Zett. Ins. Lapp. 1041, n. 5 (1840). *Cordulia arctica*, Selys Rev. Odon. 71 (1850); Hag. Ent. Ann. 48 (1857); McLach. Cat. Brit. Neur. 13 (1870). *Epitheca arctica*, Selys Bull. Acad. Belg. 2 xxxi. 297 (1871). *Somatochlora arctica*, Kirby Syn. Cat. Neur. Odon. 48 (1890). *Cordulia subalpina*, Selys Bull. Acad. Brux. 2 90 (1840). *Cordulia alpestris*, Hag. Syn. Lib. Eur. 41 (1840).

Zetterstedt's description.

Æ. arctica: tota viridi-ænea, fronte puncto utrinque ad oculos, abdominis incisuris basalibus segmentique tertii macula laterali, flavis; alis cinereo-hyalinis subimmaculatis, membranula appendicea sordide albida ♀ (Long. corp. 11-12, al. exp. 17-18 lin.). *Mas et Fem.* Similis et affinis priori s. *Æ. metallicæ*, sed magnitudine duplo minori, fronte tantum puncto utrinque ad oculos (nec limbo inferiori toto), flavo, alis (♀) subimmaculatis,

appendicibus caudalibus brunneis, nec nigris, ut et loco natali ab illa facile dignota. Alæ cinereo-hyalinæ, basi infima nigra, flavedine levissime inducta, versus apicem in regione stigmatis nigricantis umbra fusca leviter tinctæ. Cellula triangularis ad basin et membranula appendicea ut in præcedente. Squamula aperturam ventralem juxta anum tegente incumbens. In viva oculi dimidietate inferiori glauci, superiori castanei, in mortua toti brunnei. (J. W. Zetterstedt. "Insecta Lapponica Descripta," p. 1041, n. 5, 1840.)

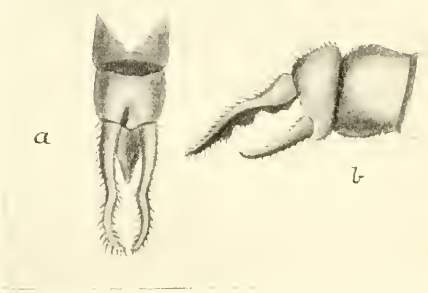


Fig. 28.—Anal Appendages of Male of Somatochlora arctica.
(Magnified.)
a., Dorsal view. *b.*, Lateral view.

Size.

Length of Male, 49mm.; expanse of wings, 67mm. Length of Female, 49mm.; expanse of wings, 68mm.

Male Imago.

Head and *thorax* bronze-green; a yellow spot in front of each eye, and the base of the upper lip yellow. *Eyes* green. *Wings* suffused with a yellowish tint,

deeper near the costa. *Pterostigma* blackish-brown. *Accessory membrane* white, darker towards the anal angle of the hind-wing, which in this sex is pointed. *Legs* black. *Abdomen* bronze-green, with a slight coppery tint; much constricted at segments 3 and 4, and expanding a great deal beyond. *Anal appendages* as long as last two segments; *lower* ones for rather more than the basal half slightly curved, then bending outward with a more decided curve, and finally almost approaching at the tips; rounded above, but with three teeth below; *lower* short, triangular, turned up slightly at the tip. (See Fig. 28.)

Female Imago.

Hind-wing rounded at anal angle. *Pterostigma* dark brown, paler when immature. *Accessory membrane* narrow, white. *Abdomen* not constricted, but gradually tapering towards the anal extremity; two oblong yellow spots near the base of segment 3. *Anal appendages* leaf-like, rather small. *Vulvar scale* triangular, pointed, and spout-like.

Date.

June appears to be the month for this species at Rannoch, though it may no doubt be taken in July, and possibly till the beginning of August.

Habits.

C. arctica seems at Rannoch to be chiefly confined to the sloping ground in the upper portion of the Black Wood, flying in more open localities than *E. cærulea*, and preferring a bit of boggy heath or swamp, especially on a slope. It has a very tantalising way

of soaring about at some little elevation—sometimes in the open, sometimes about trees. It is no doubt bred in the little marshy pools similar to those which *Æ. cærulea* frequents, and not in the loch itself. (C. A. Briggs, in *litt.*)

Distribution.

But few localities can be given for this northern Dragonfly. Its best known centre is at Rannoch, in Perthshire, where it is usually not uncommon, though difficult to catch. Mr. J. J. F. X. King has a specimen in his cabinet taken by the late Dr. Buchanan White in 1880, at Strathglass, in Inverness-shire. In June, 1895, Mr. K. J. Morton took a female in the Breadalbane district of Perthshire, that being the only one he saw with certainty. There is also one Irish locality, Killarney, from which Mr. McLachlan has in his cabinet a male, presented to him by Mr. Birchall, who captured it in 1862.

14. Cordulia* ænea, Linn.

(PLATE IX.)

Synonymy.

Libellula ænea, Linn. Syst. Nat. i. 544, n. 8 (1758); Linn. Faun. Suec. 373 (1761); Harr. Expos. Eng. Ins. 92, t. xxvii., f. 2 (1782); Charp. Lib. Eur. 91, t. 14 (1840). *Cordulia ænea*, Steph. Illustr. Brit. Ent. Mand.

* Derived from κορδύλη, a club. One would therefore have expected *Cordylia*, and *y* instead of *u* also in *Cordulegaster* (p. 157), the first part of which is derived from the same word.



Cordulia ænea

(nat. size).



Oxygastra curtisii

(nat. size).

vi. 89 (1836); Evans Brit. Lib. 24, pl. xiv., f. 3 (1845); Selys Mon. Lib. Eur. 67 (1840); Selys Rev. Odon. 75 (1850); Hag. Ent. Ann. 48 (1857); McLach. Cat. Brit. Neur 13 (1870); Kirby Syn. Cat. Neur. Odon. 52 (1890).

Linnæus' description.

L. thorace æneo-viridi (C. Linnæus, "Systema Naturæ," i. 544, n. 8, 1758). Libellula ænea thorace æneo-viridi. Libellula thorace viridi nitido: lineis flavis, alis pallidis, abdomine nigro, Fn., 768. Descr. *Caput et thorax* viridia, nitida. *Oculi* subfusci; *alæ* flavescente-albæ in quibusdam ad basin flavæ. Punctum marginale fuscum. *Abdomen* cylindricum nigrum, subtus flavum marginis colore deaurato: *cauda* diphylla, angusta. β. Libellula viridi-inaurata; alis pallidis, pedibus nigris. . . . Descr. Præcedenti simillima. Mas cauda quadridentata, dentibus superioribus pilosis, inferioribus singulis duplici denticulo. Feminæ cauda foliolis 2 lanceolatis. Caput, thorax, abdomen cupreo-inaurata. Thorax pilosusabsque maculis; margo alarum posticarum pone versus abdomen macula membranacea. Oculi prasini. Labium pallidum. Abdomen subtus hinc inde pallide albescens. (C. Linnæus, "Fauna Suecica," p. 373. n. 1466, 1761.

[In the first edition of the Fauna Suecica (1746) Linnæus describes on page 231 two insects, Nos. 768 and 769, without a specific name, of course, as he had not then adopted his binomial system of nomenclature. Of these, 768 may well apply to *Somatochlora flavomaculata*, and 769 to *C. ænea*. In 1758, in the tenth edition of the "Systema Naturæ," he puts the two together, and first applies the specific name *ænea*. In the second edition of the "Fauna Suecica" (1761) he again separates them, and makes the first (*S. flavomaculata*) *ænea*, while the *C. ænea* of to-day is given as a variety (β.) of the former. That this was the real view

of Linnæus is confirmed by reference to his collection, where a *flavomaculata* is labelled *ænea*, and an *ænea* is placed below it. The specific names for the two species as now employed were used by Vander Linden (1825), and though his naming is clearly not in accordance with the views of Linnæus in 1761, it will perhaps be unnecessary to find a new name for the second species, especially as both are fairly descriptive of the insects to which they are at present applied.*]

Size.

Length of Male, 47·5mm. to 50mm.; expanse of wings, 66mm. to 70mm. Length of Female, 46mm. to 49mm.; expanse of wings, 68mm.

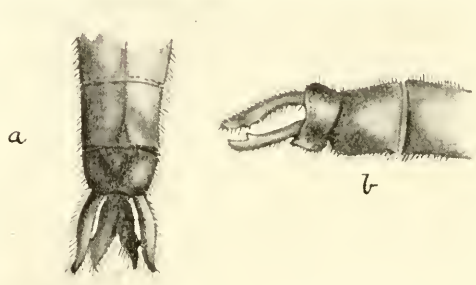


Fig. 29.—Anal Appendages of Male of Cordulia ænea.
(Magnified.)
a., Dorsal view. *b.*, Lateral view.

Male Imago.

Head bronze-green, labium orange, rhinarium yellow *Eyes* green. *Prothorax*, yellow margin in front and behind. *Thorax* bright bronze-green, covered with russet down; projections between the wings orange. *Legs* long, black. *Wings* hyaline, sometimes with a

* See in E. M. M., 1898, p. 228, a statement of the case by Mr. R. McLachlan.

very pale yellowish tinge; base of hind-wings saffron, and the base of the fore-wings to a smaller degree; anal angle of hind-wings bluntly pointed. *Pterostigma* 2·5mm., rather narrow, black. *Accessory membrane* rather wide, dark, but shading off to white at the base. *Abdomen* swollen at first and second segments, constricted at third, gradually swelling to the eighth, and then contracting a little again; bronze-green, generally with a coppery tinge in the posterior half; suture between second and third segments yellow; under side of second segment yellow. *Anal appendages* blackish-bronze, as long as last two segments; upper, cylindrical, blunt, slightly divergent; lower one as long as the upper, deeply bifid, parts divergent and pointed, and with an external lateral projection towards the tip (Fig. 29).

Female Imago.

Closely resembling the male in general. Chestnut tint to upper surface of eyes (De Selys). *Wings* slightly tinged with saffron; saffron suffusion at base of wings more developed; anal angle of hind-wings rounded. *Abdomen* stouter, more uniform after third segment. *Anal appendages* as long as ninth and tenth segments, somewhat spindle-shaped. *Vulvar scale* not prominent, deeply bifid, two parts bluntly triangular, yellowish.

Immature Colouring.

Pterostigma yellow, then brown. In a very immature male the *accessory membrane* was white, and the saffron suffusion near it very pale. The deep saffron tint of some females is perhaps due to immaturity, and may disappear to a great extent later.

Variation.

When mature this insect does not appear to be subject to much variation. Usually the triangle of the fore-wings has a transverse nervure, and that of the hind-wings none; but it may be absent from the fore-wings also—sometimes from one wing only.



Fig. 30.—Nymph of Cordulia ænea.
(× 2.)

Nymph (Fig. 30).

Body of a general sepia tint, not very hairy, but possessed of some in parts; broad and somewhat flattened; length, including anal appendages, 22·5mm.; greatest breadth 8mm. *Head* somewhat pentagonal in shape; width, in region of eyes, 6mm., narrower from front to back. Antennæ seven-jointed; basal two

swollen; distal five longer, slender; apical one pointed. *Mask* tapering backwards to the hinge, and reaching quite to the posterior edge of the insertion of the mid-legs; narrow at the hinge; spoon-shaped; covering the face; palpi triangular, serrated where they approach in the mid-line; free joint slender, pointed; long hairs near the outer margin of the palpi, and a row across the body of the mask on the upper surface, in a line with the insertion of the palpi; front border produced into an obtuse angle. *Eyes* small, prominent, conical, situated at the fore corners of the head; vertex rather prominent; a dark patch on each side between it and the eyes. Occiput rather broad, rough, hind-margin a little concave. *Prothorax* rather narrow, collar-like, with a raised rim behind, dark mid-dorsally. *Thorax* with oblique interrupted pale lines, separated by dark lines, one of which extends to the sides of the pro-thorax. *Meso-thoracic spiracles* exposed. *Wing-cases* 6mm. long. *Legs* long and rather slender, hairy; fore- and mid-tibiæ and femora with two dark brown bands, hind ones apparently with one; distal joint of tarsi darker than the rest; length of legs, first pair 15mm., mid- 18mm., hind- 22mm. *Abdomen* with three elliptical paler patches on each side of upper surface of segments 4 to 8; under-surface dull yellowish-green; segments fairly equal, except the tenth, which is very small; hind-margin of ninth truncated. Lateral hooks on segments 8 and 9; mid-dorsal stumpy, recurved ones on the hind-margin of segments 4 to 9, that on 9 being very short—most of these are situated in a conspicuous pale area. *Anal appendages* short, pointed; upper one triangular, laterals cylindrical, inferiors a little longer than

the rest. *Male projection* somewhat rectangular, margin slightly hollowed behind; surface somewhat rounded at each hind corner. *Habitat* at bottom of ponds, canals, &c. but apparently not in the mud. [From Surrey specimens.]

Date.

Cordulia ænea is one of the spring Dragonflies, and its earliest recorded date seems to be May 10, the locality being Surrey. It is probably at its best in average seasons in early June, and does not extend far into July. In 1891, however, Mr. Briggs saw one at Bookham, in Surrey, on September 13, under circumstances that scarcely allowed of his being mistaken as to the species. Perhaps this particular insect emerged at an abnormally late date, an occurrence which does not appear to be uncommon in some species of Dragonflies.

Habits.

When *C. ænea* frequents a pond, it often hovers and circles about not far above the surface of the water, some few yards from the bank; but along a certain canal in Surrey, where on one occasion large numbers were on the wing together, they flew backwards and forwards with great constancy, within a foot or so of the bank not far from the water. Though not particularly timid insects, they are not easily caught. They seem to be very adept at avoiding the net, although it appears to be quite an easy matter to intercept their course.

Distribution.

Not many records have been made of the occurrence of this insect, and most of those that exist are of

localities in the south of England, where perhaps it is chiefly to be found. In Wales, Scotland, and Ireland it does not appear to have been observed. Localities or records that have come under my notice are: *Hampshire:* Woolmer Forest and Hartley Wintley (W. H. Bath, in "Naturalists' Gazette," 1891). *Berkshire:* Wellington College (J. E. Tarbat); Bulmershe Park, near Reading (A. H. Hamm). *Surrey:* Esher Common, near Byfleet, and Ockham Common (W. J. L.); Bookham (C. A. Briggs). *Essex:* Epping district (H. Doubleday). In W. H. Bath's "Handbook" there is a long list of localities, but he does not say who is his authority for them. They are: Epping Forest, Godalming, Woodford in Essex, Hampstead, New Forest, Woolmer Forest, Malvern, Starston and Costessey Woods in Norfolk, Martlesham Heath in Suffolk, Windermere, near Wisbeach, Pennington Common in Hants, Staffordshire, and Bishop's Auckland in Durham. It will be noticed that some of these are in the north of England.

15. Oxygastra curtisii, Dale.

(Plate IX.)

Synonymy.

Cordulia curtisii, Dale Loud. Mag. Nat. Hist. vii. 60 (1834); Curt. Brit. Ent. xiii., t. 616 (1836); Steph. Illustr. Brit. Ent. Mand. vi. 90 (1836); Selys Mon. Lib. Eur. 68 (1840); Evans Br. Lib. 24, pl. xv. f. 2-3 (1845); Selys Rev. Odon. 77 (1850); Hag. Ent. Ann. 49 (1857); McLach. Cat. Brit. Neur. 13 (1870); *Oxygastra curtisii*, Selys Bull. Acad. Belg. (2) xxxi. 306 (1871); Kirby Syn

Cat. Neur. Odon. 52 (1890). *Cordulia compressa*, Steph. Syst. Cat. 309, n. 3436 (1829), no description. *Libellula nitens*, Fonsc. Ann. Soc. Ent. Fr. vi. 146, pl. v. f. 3 (1837).

Dale's description.

Viridi-ænea; abdomine medio flavo-maculatis (♀ compresso et alis flavescentibus). About the size of *C. ænea*. Brassy-green; body compressed, with a row of oblong yellow spots down the back, absent on the seventh and eighth joints only; head notched in front; wings very pale greenish-yellow, slightly yellow at the base in the male; yellow-brown in the female, along the costa of all the wings, suffused to their centre; stigma and nervures piceous (Loudon's "Magazine of Natural History," vol. vii., p. 60, January, 1834).

> [Stephens had already named the insect *Co. compressa* (Stephens' "Systematic Catalogue," p. 309, n. 3436) in 1829, but he did not describe it till 1836. Evans gives *compressa* as a synonym (Br. Lib., 1845.)]

Stephens' description.

Æneo-viridis, nitida, abdomine compresso, lineâ interruptâ dorsali luteâ, appendicibus analibus maris superioribus incurvatis, pilosis, inferioribus brevibus emarginatis [Long. corp. 2 unc.—2 unc. 1½ lin.; exp. alar. 2 unc. 10 lin.—3 unc.]. Brassy-green, shining; mouth below and streak on the labrum luteous; eyes greenish; thorax clothed with pale down, its extreme apex and two indeterminate spots towards the base of the wings reddish; abdomen clavate, the two basal segments with a narrow luteous streak, the third to the seventh with an interrupted dorsal line, and the eighth with a spot at the base luteous, ninth immaculate, tenth with a luteous

patch ; anal appendages moderate, upper pair pilose and incurved, lower pair shorter, emarginate ; legs black ; wings hyaline. Female of a brighter green, the abdomen compressed and carinated, the dorsal streak broader, and the margins of the third, fourth, and fifth segments luteous ; wings flavescent, with a black stigma (Stephens' "Illustrations of British Entomology, Mandibulata," vol. vi., p. 90, June 15, 1836.)

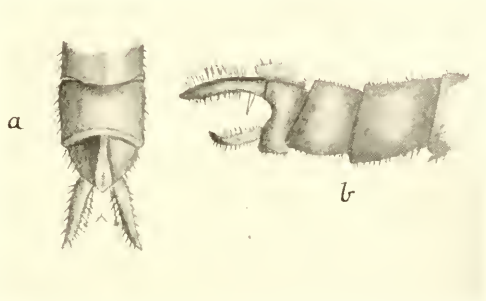


Fig. 31.—Anal Appendages of Male of Oxygastra curtisii.
(Magnified.)
a., Dorsal view. *b*., Lateral view.

Size.

Length of Male, 53mm. ; expanse of wings, 71mm. Length of Female, 50mm. ; expanse of wings, 74mm.

Male Imago.

Face metallic green, with one yellow transverse streak; lower lip orange. *Thorax* metallic green, very hairy, prominences at base of, and between, wings brownish-orange. *Legs* black. *Wings* hyaline. *Accessory membrane* white. *Pterostigma* small, almost black, 2mm. long. *Abdomen* cylindrical, slightly swollen at

the base, the last four segments dilated ; bronze-green ; segments 1 and 2 with an orange mid-dorsal streak, segments 3 to 7 with a long mid-dorsal spot constricted about the middle ; this spot gets smaller as the segments proceed posteriorly ; segments 8 and 9 are entirely bronze. 10 is raised mid-dorsally and there yellow. Upper *anal appendages* cylindrical, hairy, black, turning outwards at the point, with a sharp spine on each near the base below, pointing vertically downwards ; lower appendage shorter, orange, bifid, with the black tips turned up (Fig. 31).

Female Imago.

Colouring much the same as that of male, dorsal spots more conspicuous, absent from segment 7. *Abdomen* much compressed, but rather swollen at each extremity. *Wings* much clouded with saffron, especially towards the costal margin. *Pterostigma* black, a little over 2mm. long. Vulvar scale hollowed out into a groove, projecting but little, simple, not notched at border, less prolonged than with the other species. The two anal appendages are as long as the last segment, nearly black, downy, cylindrical, and pointed. The eleventh segment is yellowish.

Date.

June and July are the months when *O. curtisii* should be sought for upon the wing.

Distribution.

On June 29, 1820, Mr. J. C. Dale discovered this new British Dragonfly on Parley Heath in Hampshire, and subsequently found it at Hurne in Dorsetshire as



Gomphus vulgatissimus

(nat. size).

late as July 16. On June 8, 1831, Mr. Curtis captured a specimen on the side of Ramsdown, near Heron Court, Hampshire, in company with Mr. Dale, who, in 1834, named and described it in Loudon's Magazine. It was also taken by Mr. Cocks, at Braunton Burrows in Devonshire.* From this time the insect was lost sight of till 1878, when on July 1 Mr. H. Goss took six specimens (two males and four females) on a heath to the north of Pokesdown, near Christchurch, in Hants. Four years later, in 1882, Mr. Goss again visited the locality, and on July 11 took four males. Since this date the insect has not been recorded, though there is no reason to suppose that it has become extinct. Curtis and Bath (the latter apparently following Curtis) say that the insect is unknown on the Continent. But this is a mistake; it is found in France as far north as lat. 48deg., in Spain, and in Portugal. From its continental distribution we should hardly have expected it in England.

16. Gomphus vulgatissimus, Linn.

(Plate X.)

Synonymy.

Libellula vulgatissima, Linn. Syst. Nat. i. 544, n. 6. (1758); Linn. Faun. Suec. 373 (1761); *Gomphus vulgatissimus*, Evans Brit. Lib. 23, pl. 14, f. 1 (1845); Selys

* Stephens thought the only locality for the species was near Brockenhurst, in the New Forest. Doubleday felt certain he saw one near Epping (E. M. M. 1871, p. 87).

Rev. Odon. 82 (1850); Mon. Gomph. 129, pl. vii., f. 6 (1857); Hag. Ent. Ann. 49 (1857); McLach. Cat. Brit. Neur. 13 (1870). *Æshna vulgatissima*, Kirby Syn. Cat. Neur. Odon. 67 (1890). *Lib. forcipata*, Don. Brit. Ins. xii., 423 (1807). *Æshna forcipata*, Latr. Hist. Nat. Crust. Ins. xiii. 8, t. 97 bis, f. 1 (1805). *Æschna forcipata*, Charp. Lib. Eur. 125, t. xxviii. (1840). *Gomphus forcipatus*, Steph. Illustr. Brit. Ent. Mand. vi. 87 (1836); Selys Mon. Lib. Eur. 89 (1840).

Linnæus' description.

L. thorace strigis octo flavicantibus (C. Linnæus, "Systema Naturæ," i. 544, n. 6, 1758). DESCR. Latera thoracis et abdominis flava. *Alæ* albæ, nullo modo flavescentes ut in Rajana; a dorso longitudinaliter fusca. *Puncta* marginalia alarum fusco-ferruginea (C. Linnæus, "Fauna Suecica," 373, n. 1464, 1761).

Size.

Length of Male, about 49mm.; expanse of wings, about 62mm. Length of Female, about 49mm.; expanse of wings, about 68mm.

Male Imago.

Head black, hairy; frons, lower margin and sides of nasus, a band across the labrum, and genæ, yellow; a yellow band also across the head; between the eyes a transverse line in front of vertex. *Eyes* green, small, far separated from one another. *Prothorax* black, with a yellow spot on each side, and two mid-dorsal ones of same colour, the hind one being double. *Thorax* yellow, front edge black; five longitudinal dorsal black lines, and one on each side at the junction of meso- and

meta-thorax ; at the attachment of the wings the thorax is black, with yellow points ; between the wings yellow. *Wings* hyaline, with a faint yellow tinge towards the base ; anal angle of hind-wings pointed and deeply-cut out previous to the point. *Pterostigma* brown or orange-brown, between black nervures ; on fore-wings 3mm., on hind ones rather longer. *Accessory membrane* extremely narrow, whitish. *Legs* black, coxæ yellow above. *Abdomen*, first and second segments swollen, third much contracted, then gradually expanding to the eighth, and afterwards contracting again ; seventh, eighth, and ninth segments winged laterally ; colour black with yellow markings ; first segment nearly all yellow ; second with dorsal three-lobed spot, a pair of yellow auricles at sides, lower part of sides yellow, and male organs black and prominent ; segments 3 to 7, with yellow mid-dorsal streak, wider at base, decreasing in extent posteriorly ; sutures between segments 6, 7, 8, and 9 yellow ; between segments 3, 4, 5, 6, and 7 small lateral spot at sutures, much more enlarged on 8 and 9. *Anal appendages* black ; upper, short, cylindrical, divergent ; lower one divided, in appearance resembling the upper two, and lying below them.

Female Imago.

Very closely resembling male, but *abdomen* less constricted about segments 3 and 4 ; more yellow on sides, anal angle of hind-wings rounded, no yellow tint at base, no auricles on second segment of abdomen. *Pterostigma* 3mm. on fore-wings, 4mm. on hind ones. *Anal appendages* short, black, pointed. *Vulvar scale* not projecting, triangular, with the apex bifid, channelled below.

Variation.

De Selys* mentions that Dr. Hagen once took a male with the dorsal yellow line prolonged to the eighth segment, and appearing on the ninth as a yellow point. These characters disappeared at death.

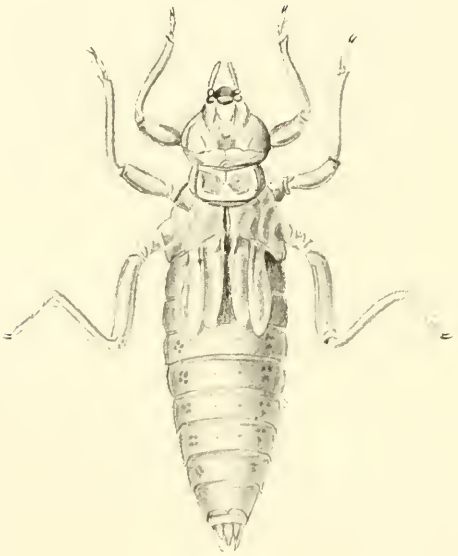


Fig. 32.—Nymph of Gomphus vulgatissimus (× 2).
(After L. Cabot.)

Nymph (Fig. 32).

"Length, 31mm.; breadth, 8mm. Head cordate, flat. Eyes large, prominent. Ocelli developed. Oblique groove extending from lateral ocellus to front angle of eye. Vertex square, a little elevated. Part behind the

* "Revue des Odonates," p. 83.

eyes short, notched at middle; small elevated spots behind eyes. Antennæ, two basal joints short, globular, second shortest; third nearly twice a long as both basal, dilated, somewhat bent up at tip; fourth rudimentary. Mask reaching to the fore-legs, quadrangular, channelled in middle, sides bent up, cut straight at fore-border, middle third finely denticulated, and surmounted by comb of bristles. Palpi short, arcuated, finely denticulated at basal half, end hook stout; movable hooks long and sharp. Prothorax oval, fore-border elevated, a flat impression on each side. Wing-cases reaching nearly to fourth segment. Legs strong, formed for burrowing. Hind-legs more widely separated at base. Fore and middle legs short, about equal size. Femora short, stout, bent inward; tibiæ longer, with strong outer spine at anterior end; tarsi two-jointed, short, basal joint very short, claws sharp. Hind-legs longer, reaching nearly to ninth segment, flat; tarsi three-jointed, second half the length of third. Abdomen long, flat, lanceolate, decreasing in size after sixth segment. Side border sharp; segments 2 to 9 with large flat spots. No dorsal hooks. Segments 6 to 9 with lateral spines; spines of ninth half as long as tenth segment. Segments of equal length, except the tenth, which is small, about one-third of foregoing, and cylindrical. Anal appendices a little longer than last segment, pyramidal, sharp. Superior one thickened at basal half; lateral superior ones shorter, sharp. Female has abdomen a little broader, and at end of eighth ventral segment a small bifid tubercle, superior appendix not thickened at basal half." (L. Cabot, "Immature State of the Odonata," Part I.

Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College, U.S.A., 1872.)*

Date.

This species is an early one, appearing in May and being over by about the end of June.

Habits.

On the wing this species has a superficial resemblance to *Cordulegaster annulatus*, except in size. Its flight is rather slow; in fact, very much slower than in some species, such as *Orthetrum cærulescens*, of about the same wing-expanse. Being not at all "wary," it is easily caught. It chiefly hovers about bushes and trees or flies along the margins of streams, and rarely takes long or high flights. In this respect it resembles more the Zygopterid Dragonflies than the Anisopterids to which it belongs. (W. J. Ashdown, *in litt.*)

Distribution.

But few localities have been recorded for this Dragonfly, which, from its conspicuous colouring, should be easily noticed. All the records, too, as far as the British Isles are concerned, are from England, though De Selys ("Revue des Odonates," p. 83) says that it has been observed in Ireland. They are: *Essex:* Near Epping (H. Doubleday). *Berkshire:* The Thames, near Reading (A. H. Hamm); near Bagley Wood (M. Burr). *Oxfordshire:* Brighthampton (Mr. Stone's specimens in the Oxford Museum). *Worcestershire:* Near Worcester

* Some empty nymph-skins, found in the New Forest while the above account of the nymph was passing through the press, confirm the general accuracy of Cabot's description.



Cordulegaster annulatus

(nat. size).

(J. E. Fletcher). *Hampshire:* New Forest (W. J. Ashdown). Evans, on Stephens' authority, gives "round London" and "in Kent."

17. Cordulegaster* annulatus, Latr.

(Plate XI.)

Synonymy:

Æshna annulata, Latr. Hist. Nat. Crust. Ins. xiii 6 (1805). *Cordulegaster annulatus*, Steph. Illustr. Brit. Ent. Mand. vi. 86 (1836); Selys Mon. Lib. Eur. 96 (1840); Evans Brit. Lib. 22, pl. 13, f. 2 (1845); Selys Rev. Odon. 104 (1850); Selys Mon. Gomph. 333, t 17 (1857); Hag. Ent. Ann. 51 (1857); McLach. Cat. Brit. Neur. 14 (1870). *Cordulegaster annulata*, Kirby Syn. Cat. Neur. Odon. 80 (1890). *Libellula grandis*,† Scop. Ent. Carn. 259 (1763). *L. forcipata*,† Harr. Exp. Eng. Ins. 78, t. 23, f. 3 (1782). *L. boltonii*, Don. Brit. Ins. xii., t. 430 (1807). *Æschna lunulata*, Charp. Hor. Ent. 29, t. 1, f. 7 (1825); Charp. Lib. Eur. 118, t. 26 (1840). *Cordulegaster lunulatus*, Ramb. Hist. Nat. Ins. Névr. 178 (1842).

Latreille's description.

Noire; trois bandes de chaque côté du corselet, et une ligne entre la seconde et troisième, grand nombre d'anneaux rétrécis ou interrompus au milieu et en dessus, sur l'abdomen, jaunes; taches marginales des ailes

* κορδύλη, fem., *a club*, and γαστήρ, fem., *abdomen*.

† Names preoccupied.

alongées . . . elle a plus de deux pouces et demi de long. (P. A. Latreille, "Histoire Naturelle des Crustacés et des Insectes," tom. xiii., p. 6, 1805.)

[Kirby, in his "Synonymic Catalogue," makes *Cordulegaster* feminine, while most authors make it masculine. As the generic name is really adjectival, agreeing with the idea of a genus, it may be of any gender suitable to the form of the word. *Cordulegaster* may, therefore, grammatically be either masculine or feminine, and, as it has generally been used as masculine, it seems better to let it continue to be so used.]

Size.

Length of Male, about 75mm.; expanse of wings, 92mm. Length of Female, including ovipositor, 84mm. to 86mm.; expanse of wings, 100mm. to 103mm.

Male Imago.

Head hairy; frons yellow, with a central black streak in front, and a black line behind along the vertex; nasus yellow, except the centre of the lower edge, which is black; labrum yellow, with black margin; genæ yellow basally; labium yellow. Vertex black; ocelli distinct. *Eyes* rather small, green, just meeting at a point; yellow triangular spot behind eyes. *Prothorax* black, bordered in front and behind with yellow, the hinder yellow line interrupted in middle. *Thorax* hairy, black; two broad yellow bands in front, and two others, also broad, on each side, with a narrow one and a spot between; at the base of the costa of each wing a small yellow spot; between the fore-wings a large one; and between the hind-wings two large adjacent ones. *Wings* long and narrow; costal margin golden; anal angle of hind-wings produced into a blunt point. *Pterostigma* narrow, black; of fore-wings 4mm., of hind-wings 5mm. *Accessory*

membrane rather long, narrow, white. *Legs* black. *Abdomen* swollen at first and second segments, then contracted, much swollen at seventh and eighth, and then contracted again ; colour black, with yellow markings ; first segment hairy, with yellow line on each side ; second with a yellow line along fore- and hind-margin, and with yellow auricles ; third to eighth with a central pair of dorsal spots almost meeting, and a streak along the hind-margin, not distinct in the eighth ; ninth with two basal yellow spots ; tenth black. *Anal appendages* black ; upper conical divergent ; lower one short, rectangular, just a little indented behind.

Female Imago.

Closely resembling the male in most respects. Anal angle of hind-wings rounded, and no auricles on second segment of abdomen. *Abdomen* but little constricted at middle segments ; eighth has fine yellow lines on the broad suture ; ninth produced to a basal point dorsally, and the sides partly wrapping round the tenth, which is small, with a dorsal longitudinal groove ; sides of ninth and tenth yellow. *Anal appendages* short, black, conical. *Eleventh segment* with yellow hairs. *Ovipositor* 7·5mm. long, divided along centre, pointed, lying close along abdomen, extending considerably beyond the eleventh segment ; no sheaths.

Variation.

Sometimes the wings are dark, especially in the females, but this is perhaps more a sign of age than of variation. In the south of England, according to De Selys, the yellow colouring tends to become more developed.

Oviposition.

The female does this apparently by dipping the tip of her abdomen in the water at random.

Egg.

Length just over 1mm.; breadth about two-thirds of a millimetre. In shape they are nearly elliptical, and there is a pedicel at one end. Colour yellowish-white. Contents granular. [From specimens extracted from the body of a female taken in the New Forest, August, 1897, and preserved in spirit.]

Nymph (Fig. 33).

According to Mr. L. Cabot this nymph is not to be distinguished from that of *C. sayi*, which he thus describes: "Length 40mm. Head short, broad, Breadth twice the length, sides straight, rounded off behind so that the hind-border in front of prothorax is half the width of fore-border. Vertex flat. Hind-border somewhat indented. Eyes small, round, prominent, placed at forward lateral angles of fore-border of head, with triangular piece projecting inward. Ocelli visible, especially the lateral ones. Antennæ seven-jointed, tapering, slender; the two basal joints thicker and more rounded; third longer than second; joints three to seven form a rather slender seta. Mask large, extending a little beyond the middle legs, triangular, contracted behind; the sides bent up, hollowed back of fore-border, which is prolonged into a bifid tip, surmounted by a short hairy comb. Palpus broad, enlarged at inner border and deeply denticulated, the denticulations of the opposite palpi closely fitting into one another. Movable

hook short, sharp, and slender. Prothorax half the length of head and two-thirds the breadth, indented in the middle, raised at fore part in small transverse lobe, at hind-part border raised, and thicker in the middle. Stigmata large, open. Legs very hairy, flattened, formed for running. Femora angular, thick, and a little bent. Tibiæ about equal in length to femora. Tarsi three-

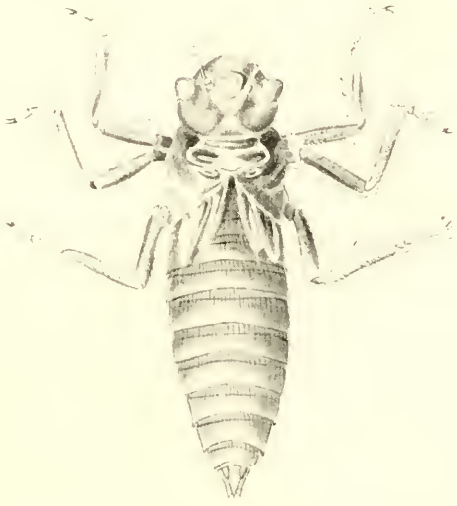


Fig. 33.—Nymph of Cordulegaster annulatus, not full grown. (× 2.)
(After L. Cabot.)

jointed, more than half as long as tibiæ; first joint short, third longest; claws very sharp. Hind-legs reaching the seventh segment. Abdomen long, rounded above, tapering gradually. Largest part at middle, as wide as head; no dorsal hooks. Segments 8 and 9 with lateral spines. Segments of about equal length. Three anal appendices of twice the length of

tenth segment, pyramidal, sharp; superior somewhat shorter; lateral ones very short and sharp. At the end of eighth ventral segment a bifid triangular vulva nearly equal in length to ninth segment." (L. Cabot, "The Immature State of the Odonata." Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College, U.S.A., 1872).

Date.

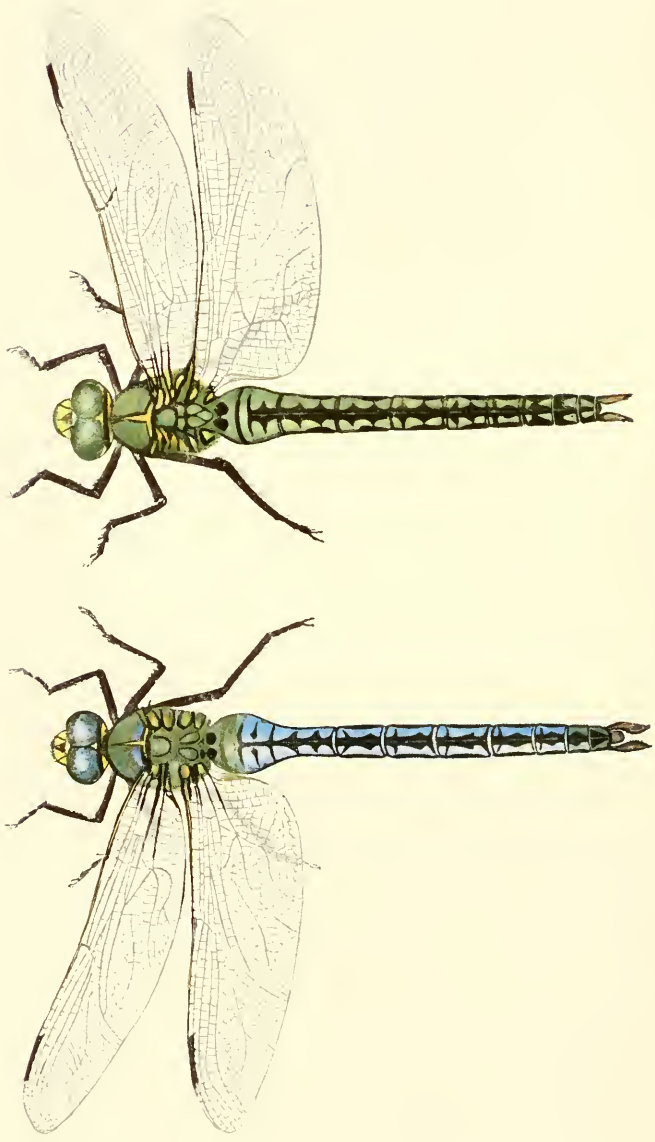
This insect appears on the wing in June, and continues well into August, if not later. In the New Forest it is plentiful, and in good condition in the early half of the latter month.

Habits.

Owing to its custom of hawking backwards and forwards along the streams close to the surface of the water, this Dragonfly is usually an easy capture, and the more so because each male seems to appropriate to itself a fixed and restricted range, which, if not thoroughly disturbed, it will frequent for a long time. Especially is this habit noticeable over the streams in the New Forest, and Mr. Morton calls attention to much the same habits along the burn-sides and in the hollows on the moors in Perthshire. But it is a powerful insect, and on occasion its evolutions become rapid and its flight lofty.

Distribution.

This fine Dragonfly is well represented in Great Britain. As regards the Sister Isle, there are no definite records, but De Selys ("Revue des Odonates," p. 107), says: "Se trouve aussi en Irlande sur les lacs du nord";



Anax imperator
(nat. size).

and Mr. K. J. Morton records it as probably seen near Glasslough, Co. Monaghan. English and Scotch localities are as follow: *Inverness-shire:* Aviemore (K. J. Morton); Strathglass, Insh, and Loch-an-Eilan (J. J. F. X. King). *Argyllshire:* Ben Cruachan, Ledaig, and near Tobermory (J. J. F. X. King). *Perthshire:* Breadalbane country (K. J. Morton); Rannoch (G. T. Porritt). *Edinburgh:* Near Edinburgh (De Selys). *Cumberland:* Lodore, near Derwentwater (O. Whittaker). *Cheshire:* Chester district (J. Arkle). *Lancashire:* Heaton near Bolton, and N.W. corner of Lake Windermere (O. Whittaker). *Westmoreland:* Langdale (J. J. F. X. King). *Merionethshire:* Maentwrog, Arthog, and near Barmouth (J. Arkle); Tan-y-bwlch (A. D. Imms). *Warwickshire:* Birmingham district (A. D. Imms). *Worcestershire:* Wyre Forest (R. C. Bradley); Near Worcester (J. E. Fletcher). *Northamptonshire:* Near Peterborough (W. J. Ashdown). *Surrey:* Ottershaw (A. Reed). *Berkshire:* Wellington College (J. E. Tarbat); near Reading (A. H. Hamm). *Hampshire:* New Forest (W. J. L.); Bournemouth (W. J. Ashdown). *Devonshire:* Dartmoor (J. E. Tarbat); Lynmouth (C. A. Briggs). *Cornwall:* Bude (C. A. Briggs). *Guernsey:* (W. A. Luff).

18. Anax imperator, Leach.

(Plate XII.)

Synonymy.

Anax imperator, Leach Edin. Enc. ix. 137 (1815); Kirby Syn. Cat. Neur. Odon. 84 (1890). *Æshna formosa*, Lind. Opusc. Scient. iv. 158, t. 4, f. 1 (1823); Mon. Lib.

Eur. 20 (1825). *Anax formosa*, Steph. Illustr. Brit. Ent. Mand. vi. 81 (1836); Selys Mon. Lib. Eur. 117 (1840); Evans Brit. Lib. 20, pl. 9, f. 2, male (1845). *Anax formosus*, Selys Rev. Odon. 110 (1850); Hag. Ent. Ann. 54 (1857); McLach. Cat. Brit. Neur. 14 (1870). *Æschna azurea*, Charp. Hor. Ent. 31, t. 1, f. 1 (1825); Charp. Lib. Eur. 99, t. 17, and t. 45, f. 1 (1840).

Leach's name.

In the Edinburgh Encyclopædia, Vol. ix., p. 137 (1815), we find that Leach thus refers to the insect:

Genus, CCCCLXXXIV., Anax. Leach's M.S.S.

Hinder wings of the male not angulated at their anal edge, but resembling those of the female. Abdomen cylindric in both sexes, not clavate.

Sp. 1, Imperator.

Inhabits England.

In G. Samouelle's "Entomologist's Useful Compendium," p. 258, 1819, the systematic part of which was practically due to Leach, occurs the same diagnosis; but *A. imperator* is there said to inhabit "England, in the New Forest of Hampshire," and the captor is advised to stuff the insect.

> [Although we have here no actual description of the species, yet the diagnosis of the genus, of which there is but the one British species, seems to quite justify Kirby in adopting in his catalogue the specific name *imperator*, as prior to Vander Linden's name *formosus*, assigned to it in 1823. The hint to eviscerate and stuff the body is especially applicable to this species.]

Size.

Length of Male, 77mm.; expanse of wings, 104mm. Length of Female, 74mm. to 77mm.; expanse of wings, 102mm. to 108mm.

Male Imago.

Face yellow; frons prominent, with a black line along the ridge, and a blue one immediately behind it, a dark triangular spot in front of the vertex, which is small and yellowish in front; rhinarium brown; margin of labrum broadly black, of labium brownish. *Eyes* blue, in contact for a considerable distance; a yellow triangular spot behind them. *Prothorax* small, brownish, yellow behind. *Thorax* green, with two narrow lateral dark oblique lines, with a tiny spot and a V-shaped mark between them; attachments of wings yellow and brown, projections between them green. *Legs* brownish-black, under side of fore femora yellow. *Wings* hyaline; costal margin golden; other nervures black; anal angle of hind-wings rounded. *Pterostigma*, fore-wings 5mm. long, hind-wings 6mm.; narrow, brown. *Accessory membrane* rather small, dark, but white at base. *Abdomen* swollen at first and second segments, constricted in middle of third, then expanding, flattened, and of uniform width to the extremity; blue, with black markings—two spots at base of first segment, two transverse lines on second, then a medio-dorsal jagged line to extremity; segments outlined in black; on the posterior segments the blue has a greenish tinge. *Anal appendages*, upper as long as the last two segments, dark brown, at base slender, spreading at middle, then getting narrower again, rounded at end, internal margin hairy, a black irregular ridge, fairly central, extending along the upper surface; lower appendage brown, short, cut square at end, surface concave as seen from above.

Female Imago.

Closely resembling the male, but *abdomen* green and only slightly constricted at third segment. *Pterostigma* 5mm. to 5·5mm. long. *Eyes* green. *Anal appendages* rather short, 5mm. in length, brown, leaf-like; eleventh segment yellowish. *Ovipositor* red, reaching to end of ninth segment; sheaths present.

Variation.

This species does not appear to be subject to much variation. In females that have been long on the wing those organs become suffused with dull brown, and very old females are sometimes taken that have a blue abdomen, like that of the male. Charpentier figures the female with this exceptional colouring in "Libellulinæ Europææ," Tab. 45, Fig. 1.

Oviposition.

Mr. McLachlan says that "for this purpose they thrust the abdomen into the water to the extent of about half an inch."* De Selys says: "On voit celle-ci raser la surface de l'eau en déposant ses œufs sur les plantes aquatiques."† No doubt the eggs are laid within the substance of the water-plants.

Egg.

Colour white, with a pale yellowish tinge; contents granulated. Shape long, cylindrical, with rounded ends; a very tiny knob or stalk at one end. Length 1·75mm.; width ·3mm. [Extracted from the dead body of a female

* E. M. M., 1869, p. 61. † "Revue des Odonates," p. 111.

taken on Esher Common, July 18th, 1897. The body contained a large number of eggs]. (Fig. 4, No. 5.)

Nymph.

Body pale yellowish-brown, not hairy, elongated, not greatly constricted behind the thorax; length, including appendages, 54mm., sometimes rather less; greatest breadth 10mm. *Head* flat, somewhat circular in outline, 9·5mm. in transverse measurement, rather less longitudinally. *Antennæ* seven-jointed, basal two short, swollen, the rest slender, the third long. *Mask* tapering gently backwards to the joint, and reaching beyond the insertion of the mid-legs; flat; middle lobe produced in a very obtuse angle, and cleft in the centre; palpi small, cut off square at end, finely toothed, point turned inwards, movable hook long, slender. *Eyes* large, roughly pear-shaped, occupying the middle of the lateral edge of head, rounded externally, with a prolongation backwards towards the mid-dorsal line. *Occiput* rather broad, rectangular, with the hind corners rounded off, rough. *Prothorax* in centre about as wide as occiput, ridge along hind margin not prominent. *Meso-thoracic spiracles* uncovered, dark, conspicuous. *Legs* rather long, fairly stout, more than one dark ring round femora; fore-legs 15mm. long, mid-legs 20mm., hind-legs 26mm. *Leg-base-processes* short, blunt, posterior one the broader, nearly equal in length, roughly enclosing a right angle. *Wing-cases* about 10mm. long. *Abdomen* with a pale mid-dorsal line, most clear at the base of the anterior segments, where on each side is a fairly large dark spot; on each segment, except 9 and 10, there are eight tiny dark

depressions, four dorsal and four lateral; on the sides there is a mottling of lighter and darker brown, more conspicuous in some specimens than in others. No dorsal spines, but fairly long lateral ones on segments 7, 8, and 9. *Anal appendages*, upper one longer than last two segments, straight, cut off concave at end;

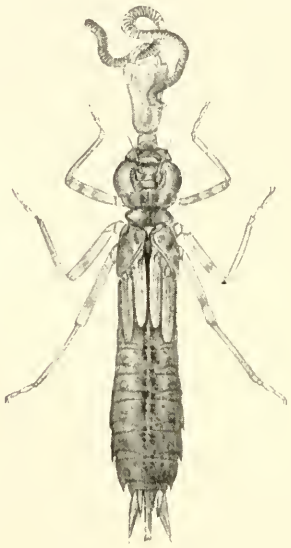


Fig. 34.—Nymph of Anax imperator.
(nat. size.)

laterals small, about half length of upper one, pointed; inferiors slightly longer than upper one, tapering to points, which cross when orifice is closed. *Male genital parts* on ventral surface of segment 9 very small. *Female valves* nearly three-quarters of length of segment 9. Male projection small, cut square at tip, about half the length of lateral appendages, not very

prominent. [From empty cases found on Esher Common, June 17 and 21, 1897, low down amongst rushes growing in shallow water.] (Fig. 34. See also Figs. 14 to 19.)

Date.

Mr. C. A. Briggs took this species immature on Ockham Common as early as May 15, in 1893. My latest captures were on August 10, on Esher Common, in 1894, and a blue-bodied female on the corresponding day of 1898 in the New Forest. June and July are the best months for the species.

Habits.

It is an extremely difficult matter to get within striking distance of these splendid insects, not only because they seem particularly suspicious of anyone in possession of a net, but also from the habit they often have of keeping well out over the water, and hawking round the edge of a reed-bed, or some similar post of vantage. Moreover, their flight is often intermittent, for the disappearance of the sun behind a cloud is in general the signal for the cessation of their restless movements to and fro, which are soon resumed, however, on its reappearance. But on one occasion, on a dull warm afternoon in June, they flew a good deal even when the sun was not actually shining. At Esher Common in the daytime they seem to rest amongst the reeds, but when evening approaches to fly to the firs as if to roost there. In that locality also the males sometimes fly low amongst the reeds, perhaps in search of the females. Patience must be a

well-developed attribute of the entomologist who wishes to catch this magnificent Dragonfly. The author took a female hawking over water in the New Forest about 7.30 p.m. at the end of July.

Distribution.

In the British Isles the range of this species appears to be confined to the south of England, where, however, in places, it does not seem to be uncommon. Localities are: *Surrey:* Esher Common, fairly plentiful, Chobham Common, and Bookham Common (W. J. L.); Crooksbury Common (E. B. Bishop)*; Ockham Common (C. A. Briggs); near Byfleet (J. E. Tarbat). *Sussex:* Near Liphook (W. J. L.). *Hampshire:* New Forest (W. J. L.). *Middlesex:* Burnt Ash Lane (R. McLachlan). *Essex:* Near Epping (H. Doubleday); Colchester, rare (W. H. Harwood). *Kent:* Herne (Evans Brit. Lib., p. 20). *Cambridgeshire:* At Cambridge (De Selys Rev. Odon., p. 110). *Guernsey:* Grande Mare and L'Ancresse (W. A. Luff).

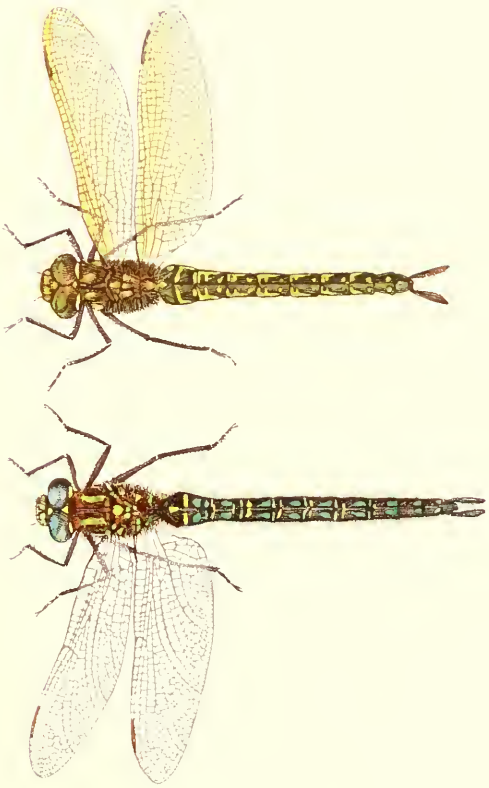
19. Brachytron pratense, Müll.

(Plate XIII.)

Synonymy.

Libellula pratensis, Müll. Faun. Ins. Fridr. 62, n. 543 ♂ (1764). *Æschna pratensis*, Selys Rev. Odon. 113 (1850). *Æschnia pratensis*, Hag. Ent. Ann. 51 (1857). *Brachytron pratense*, McLach. Cat. Brit. Neur. 14 (1870). *Libellula hafniensis*, Müll. Faun. Ins. Fridr. 61, n. 542. ♀ (1764). *Brachytron hafniense*, Kirby Syn. Cat. Neur.

* Identified by description only.



Brachytron pratense
(nat. size).

Odon. 91 (1890). *Libellula aspis*, Harr. Expos. Eng. Ins. 92, t. 27, f. 3, ♀ (1782). *Æshna vernalis*, Lind. Opusc. Scient. iv. 159, t. 4, f. 2 (1823); Lind. Mon. Lib. Eur. 21 (1825); Steph. Illustr. Brit. Ent. Mand. vi. 85 (1836). *Æschna vernalis*, Selys Mon. Lib. Eur. 100 (1840). *Brachytron vernalis*, Evans Brit. Lib. 22, pl. 13, f. 1, ♂ (1845). *Æschna pilosa*, Charp. Hor. Ent. 37 (1825); Charp. Lib. Eur. 106, t. 21 (1840).

Müller's description.

Libellula pratensis alis hyalinis: thoracis lateribus fasciis virentibus octo, antice tribus fuscis. (O. F. Müller, "Fauna Insectorum Fridrichsdalina," p. 62, No. 543,* 1764.) . . . Libellula Hafniensis alis basi margineque superiori aureis: thoracis lateribus sex-fasciatis: abdomine *nigro lineis punctisque sulphureis*. (O. F. Müller, "Fauna Insectorum Fridrichsdalina," p. 61, No. 542.)

[Müller here makes two species of the different sexes. It seems better to retain *pratensis*, the name he bestowed on the male, not only because the name of the male would be more naturally chosen, but chiefly because it has passed into common use. All that can be said in favour of the female name, *hafniensis*, is that it stands before the other in Müller's list.]

Size.

Length of Male, 57·5mm.; expanse of wings, 71·5 to 74mm. Length of Female, 54·5mm.; expanse of wings, 74mm.

Male Imago.

Face yellow, with black hairs; labium orange, with black border; border of labrum black; rhinarium black; black line between frons and nasus; black transverse line along the carina of nasus, joined by black stem to

* No. 543 is the male, and No. 542 is the female.

the very broad black line in front of vertex and eyes. Top of vertex yellow. *Eyes* blue, in contact a moderate distance ; behind eyes a small yellow triangle. *Prothorax* black, with yellowish hairs behind. *Thorax* hairy, brown above, with two yellow longitudinal lines narrowing posteriorly, and contracted just before the posterior end ; sides of thorax yellow, with three oblique black lines ; points at the attachments of the wings and the projections between them yellow. *Legs* black. *Wings* hyaline, anal angle of hind ones bluntly pointed ; costal margin yellowish, and a few of the transverse nervures near it yellow also ; other nervures black. *Pterostigma* 4mm. long, very narrow, yellow-brown. *Accessory membrane* rather small, white. *Abdomen* hairy, but little swollen at first and second segments, or constricted at third, ground colour black ; first segment black dorsally, yellow at the sides ; second, on dorsal surface a small, basal, central, yellow spot, a transverse yellow streak across middle of segment interrupted mid-dorsally, two posterior dorsal bluish spots, sides yellow and blue, auricled ; third to eighth segments, sides with an interrupted blue line, dorsal surface with two posterior blue spots, and a transverse yellow anterior streak interrupted by the mid-dorsal carina ; segments 9 and 10 without the yellow streak. *Anal appendages*, superior, long, slender, twisted, pointed, a projection on the upper surface near the extremity, a line of hairs internally ; lower, short, slightly bifid.

Female Imago.

Face brownish-yellow. On front of meso-thorax two spots instead of lines. *Wings* very pale yellowish, darker

in the costal region ; anal angle of hind-wings rounded. Spots on *abdomen* yellow instead of blue. *Anal appendages* long, flat, leaf-like. *Ovipositor* reddish, reaching end of ninth segment ; sheaths present.

Variation.

The pterostigma of the right fore-wing of a female in my possession is crossed by two transverse nervures.

Distinction from Æschnas.

Although there is little real resemblance in detail between *B. pratense* and some of the species of *Æschna*, yet there is a certain amount of superficial likeness ; but the following points will distinguish *B. pratense :* (1) The very narrow pterostigma. (2) The dense pale down, especially on thorax and front segments of abdomen. (3) The bifid lower anal appendage of the male.

Nymph (Fig. 35).

Body not hairy ; elongated, not greatly contracted at base of thorax ; colour pale brown, with greenish tinge to abdomen ; length 40mm., breadth just over 6mm. *Head* raised in the vertical region, pentagonal, 7·5mm. across transversely. *Antennæ* seven-jointed, basal two short and swollen, distal five slender, short, about equal, end one pointed. *Mask* broad anteriorly, tapering gradually backwards half-way to the joint, then nearly straight, reaching the insertion of the mid-legs ; flat ; middle lobe produced slightly in a very obtuse angle, cleft in the centre, and fringed with reddish spines ; palpi rounded somewhat at end, toothed, point turning

inwards; movable hook sharp, slender, rather short, *Eyes* rather small, somewhat pear-shaped, prominent, situated at fore corners of head, with a prolongation backwards towards the median line of head. *Occiput* rather large, outline concave back and front, lateral



Fig. 35.—Nymph of Brachytron pratense.
(× 2.)

margins sloping back very much, a raised longitudinal median line with a smooth patch on each side; hind corners spotted, rough. *Prothorax* much rounded behind, and margin there a little raised, dark in the centre. *Meso-thoracic spiracles* exposed, dark. *Legs*

short, rather stout; fore-legs 12·5mm. long, mid- 13·5mm., hind- 15·5mm.; fore femora, at least, obscurely ringed with darker brown. *Leg-base-processes* enclosing an acute angle, anterior one longer than and about half the width of posterior, both pointed (Fig. 19). *Wing-cases* about 8·5mm. long. *Abdomen* with pale medio-dorsal line, on each side of which on basal segments is a dark suffusion, which gets paler posteriorly and disappears on five; this is broader at the base of segments. On each segment as far as eight, four black dots, two on each side of mid-line, and outside these on each side two or three others; on nine and ten there are fewer. No dorsal spines. Short lateral spines on segments 6 to 9. *Anal appendages* rather short, upper one about as long as ninth segment, cut straight at tip, laterals more than half the length of upper, pointed; inferiors pyramidal, pointed, about equal in length to upper. *Female valves* below on ninth segment nearly as long as segment. The nymph described is the female. The male was dark sepia, 35mm. long, including appendages; a lateral spine indicated on segment 5. *Male projection* a triangular flap about half the length of upper appendage; genital parts below on ninth segment small. [From two specimens taken, with others, on dead sticks in the Canal, near Byfleet, Surrey, March 23, 1894; and bred May 19 and 24, 1894, one male, other female.]

Date.

Unlike most of the Æschnas, to which it bears a great resemblance, this Dragonfly appears in the spring, generally at the beginning of May, my earliest date

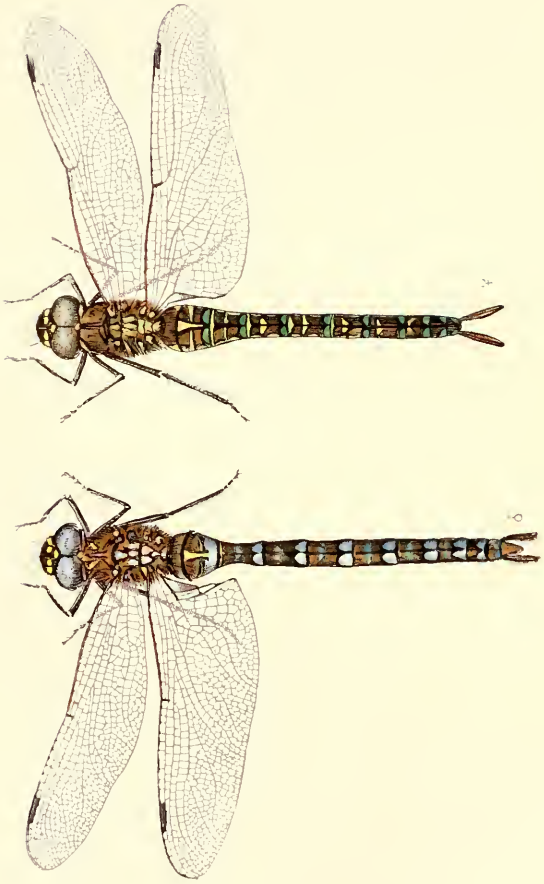
being the 14th. Mr. C. G. Hall, however, has taken it at Dover on May 5, and Mr. C. A. Briggs saw it at Egham in 1893 on April 29. Mr. Arkle records it as late as July in North Wales, and Mr. Hamm took one near Oxford in 1898 on the 9th of the same month.

Habits.

The male flies low and swiftly over ponds or along canals and ditches.

Distribution.

Not many localities have been recorded for this species. *Merionethshire:* Black Falls, Maentwrog (J. Arkle). *Cærnarvonshire:* Abersoch (J. Arkle). *Oxfordshire:* Cowley Marsh, near Oxford, one (A. H. Hamm). *Cambridgeshire:* Wicken Fen, common (W. J. Ashdown). *Norfolk:* Broads, near Lowestoft (J. Prest). *Berkshire:* Radley, one (M. Burr). *Hertfordshire:* Hertford (Evans, Brit. Lib. 22). *Essex:* near Epping (H. Doubleday); Colchester, rare (W. H. Harwood). *Kent:* Deal and Sandwich, common, and Dover (C. G. Hall); near Herne (Evans, Brit. Lib. 22). *Surrey:* Mole at Esher, Byfleet, and Ockham Common (W. J. L.); Leatherhead, Bisley, and Egham (C. A. Briggs). *Sussex:* East, common (G. T. Porritt); Abbot's Wood (G. T. Porritt); Hastings (W. H. Bath). *Ulster:* Portora, Enniskillen (J. E. R. Allen). *Connaught:* Westport (J. J. F. X. King). *Leinster:* Twy Laogh (J. J. F. X. King). *Scotland:* (De Selys Rev. Odon. 114). *Guernsey:* (W. A. Luff).



Æschna mixta

(nat. size).

20. Æschna mixta, Latr.

(Plate XIV.)

Synonymy.

Æschna mixta, Latr. Hist. Nat. Crust. Ins. xiii. 7 (1805). *Æschna mixta*, Charp. Hor. Ent. 35 (1825); Charp. Lib. Eur. 110, t. 19 (1840); Selys Mon. Lib. Eur. 102 (1840); Selys Rev. Odon. 122 (1850); McLach. Cat. Brit. Neur. 15 (1870). *Æschnia mixta*, Hag. Ent. Ann. 52 (1857). *Libellula colubercula* (?) Harr. Expos. Eng. Ins. 91, t. 27, f. 1 (1782). *Æschna colubercula*, Kirby Syn. Cat. Neur. Odon. 87 (1890). *Æshna affinis*, Steph. Illustr. Brit. Ent. Mand. vi. 85 (1836); Evans Brit. Lib. 22, t. 12, f. 2 (1845). [*Æschna alpina*, Selys Rev. Odon. 125 (1850), Kirby refers to *Æ. mixta*, Syn. Cat. Neur. Odon. 88.]

Latreille's description.

Devant de la tête jaune, avec une tache noire sur le haut; corselet verdâtre brun, avec deux petites taches en devant, et deux bandes de chaque côté d'un jaune verdâtre; abdomen ayant un grand nombre de taches diverses brunes, mêlées de taches jaunâtres et coupées par du noir; ailes sans teintes. (P. A. Latreille, "Histoire Naturelle Générale et Particulière des Crustacés et des Insectes," p. 7, 1802-5.)

[If the *colubercula* of Harris really is intended for *mixta*, his name has the priority; but, as De Selys points out,* there are several points which make this doubtful, to say the least. Many features suggest *mixta*, but the length of the pterostigma, and the thickness of the nervure which surrounds the cell at the anal

* "Revue des Odonates," p. 122.

angle, suggest *juncea*, while the inferior anal appendage is short even for that species. Moreover, Harris seems to speak of its being customary for the insect to fly in June, whereas *mixta* seldom, if ever, is on the wing so early as that month. The case for *colubericulus* being thus uncertain, it does not seem expedient to put it in place of *mixta*, which has so long been in common use.]

Size.

Length of Male, 61mm. to 66mm.; expanse of wings, 83mm. to 85mm. Length of Female, 62mm.; expanse of wings, 85mm.

Male Imago.

Face greenish-yellow; fore and hind margin of labrum black; labium orange-brown; on upper surface of frons a T-shaped black mark with its stem reaching the broad black line in front of, and along the side of, the eyes; top of vertex yellow. *Eyes* contiguous for a long distance, blue; behind the eyes a small triangular yellow spot. *Prothorax* dark, a little yellowish at the sides. *Thorax* brown, with two broad yellow oblique stripes on each side, and two tiny yellow spots in front; spots at the attachment of the wings, and the projections between them yellowish. *Legs* black. *Wings* hyaline; costal margin brown; nervures black; anal angle of hind-wings pointed. *Pterostigma* dark brown; length 3.5mm. *Accessory membrane* whitish in front, grey behind, size moderate. *Abdomen* dark brown, swollen at first and second segments; auricles on sides of second; constricted at middle of third; nearly uniform from fourth to end; first segment brown dorsally, yellow laterally; second with a yellow mid-dorsal triangular streak reaching middle of segment, in middle two yellowish transverse

lines almost reaching the yellow streak, posterior part of segment blue, sides blue and yellow; third to eighth on each segment two lateral anterior blue spots, on each side a pair of dorsal posterior blue spots, two small, yellowish, triangular, transverse, dorsal streaks near the middle; ninth and tenth with the two posterior blue spots only; round all the spots the ground-colour is blackish. *Anal appendages* long, blackish; upper edged internally with longish hairs; lower one triangular, sharp-pointed.

Female Imago.

Face brownish-yellow. *Eyes* greenish. Anal angle of hind-wings rounded. *Pterostigma* orange-brown, the yellow triangular streak on second segment of abdomen extending along nearly the whole of segment. *Abdomen* not constricted at third segment; blue spots replaced by greenish-yellow. *Anal* appendages very long, rather narrow. *Ovipositor* curved inwards, pointed, as long as ninth segment.

Distinction from Æ. juncea.

There is a great resemblance between *Æ. mixta* and *Æ. juncea*, but the following points will serve to distinguish them: (1) *Æ. mixta* is smaller than *Æ. juncea*. (2) It has no black line separating frons from nasus. (3) The costal margin of the wings is brown in the former and golden in the latter. (4) The arrangement of the nervures at the anal angle of the hind-wings of the male is different in the two species (Fig. 36). (5) Pterostigma in *juncea* is longer than in *mixta*.

Egg.

In colour pale yellow; in shape long and cylindrical, one end being rounded and the other coming more to a point. This latter end was inserted in a kind of very thin calyx, formed of more or less hexagonal cells, which also came to a point, apparently of attachment. Probably this calyx did not really belong to the egg. Granulated in appearance, due no doubt to the contents. Length, 1·6mm.; breadth ·3mm. [Extracted from the dead body



Fig. 36.—Anal Angle of Male Hind-wing.
1, Æschna juncea. 2, Æschna mixta. *a.*, Accessory membrane.

of a female caught on Ockham Common, September 11, 1897: it contained a large number of eggs.] (Fig. 4, No. 8.)

Nymph.

Length, 33mm.; breadth, 7mm. Similar to *Æ. cyanea*. *Body* shorter, and stouter in proportion. *Head* flatter. *Eyes* larger and more prominent, separated from occiput by nearly straight line. *Vertex* more in the same plane with the eyes. *Occiput* shorter and straighter behind. Bands on hind angles less marked; color grayish; a

pale elongated spot on each side of median line, and a narrow pale band on hind angle, often scarcely discernible. *Mask* long, extending through middle legs, gradually enlarged; front border a little more than twice width of base; middle third of front border somewhat produced and rather widely cleft, with comb of hairs. Palpus broad, rounded at upper angle, and produced in very short black teeth at lower angles; denticulation beneath discernible; movable hook, reaching the base of opposite one. *Prothorax* as broad as back part of occiput, rounded behind. *Processes* stout and blunt, not much separated, anterior more contracted. (Fig. 19, No. 3). *Legs* very slender; hind legs extending to ninth segment, ash-gray; femora with two pale rings. *Wing-cases* extending to middle of fifth segment. *Abdomen* short, stout, tapering from seventh segment; dorsum very convex, finely granulated as in *Æ. cyanea*, but with whitish hairs; colour grayish; each segment with eight darker impressed spots, four on middle and two on each side near margin. Segments of nearly equal length, except tenth, which is half as long; lateral spines on segments 6 to 9; that of ninth nearly as long as tenth segment. Inferior *appendages* as long as last two segments, triangular, sharp; middle appendage notched, not so long as inferiors; lateral superiors rather more than half length of middle one, cylindrical, slender, and sharp. Male projection conical, rather sharp, nearly as long as lateral superiors. Male genital parts slightly marked; female valve extending somewhat beyond ninth segment. (L. Cabot, "Immature State of the Odonata," Part II. Cambridge, U.S.A., 1881.)

Date.

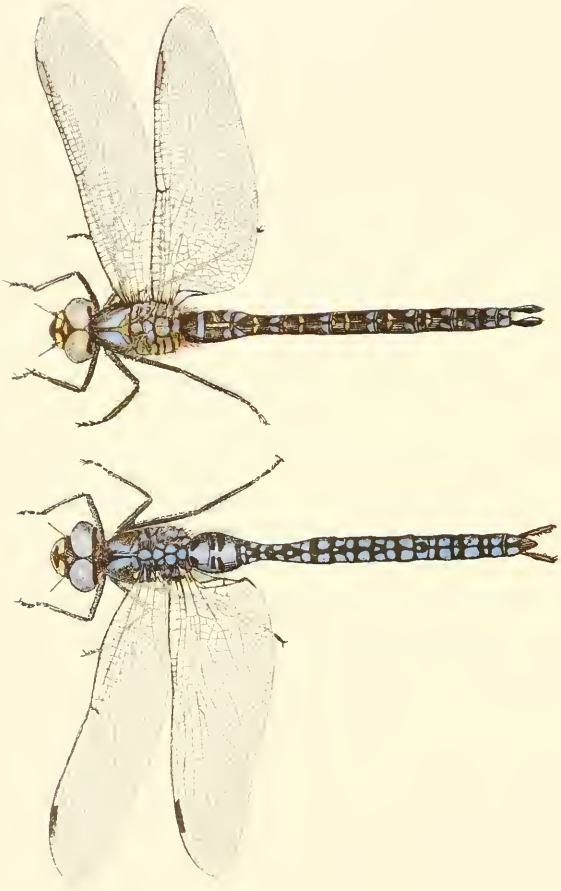
This is one of the later summer Dragonflies, the commencement of whose period of flight seems to be uncertain. Mr. R. C. Bradley records it on August 2 at Bournemouth, and Mr. S. Stevens exhibited one at the Entomological Society of London on January 5, 1876, which he had picked up dead, or nearly so, in his garden in the middle of November. Most of the recorded captures have, however, taken place in September. Those I have myself made (three in all) were in that month, on the 10th, 11th, and 12th, though in three different years.

Habits.

It appears to be the usual custom of this species to fly backwards and forwards and round about within a very limited range, but at a considerable height above the ground. As it is in addition very wary, it is almost impossible for anyone to come within reach of a specimen with the net. These habits are perhaps partly responsible for the fact that so few captures have been recorded, although the species is, of course, undoubtedly scarce.

Migration.

Mr. F. M. Campbell, writing in the *Entomologists' Monthly Magazine* for 1885, p. 192, says: "On September 23, 1884, I witnessed a flight of Dragonflies in France on the banks of the Gironde, about seven miles from St. Estèphe. I first noticed it at 5 p.m., and it lasted from one hour and a half to one hour and three-quarters. The flies were from 5ft. to 15ft. apart, and were taking a steady up-river course, at a height



Æschna cœrulea

(nat. size).

of from 10ft. to 15ft. from the ground. The width of the flight was about 150 yards. If I may judge from size, there were two species. I managed to catch one of the larger examples, which I have submitted to Mr. McLachlan, who informs me that it is *Æschna mixta*, ♂. The weather was fine and warm, but the sky was clouded, and rain had fallen during the day; there was little or no wind."

Distribution.

This Dragonfly seems to be almost confined to the south-eastern corner of England and the Channel Islands, and even from there but few captures have been recorded. Localities are: *Surrey:* Esher Common and Ockham Common, scarce (W. J. L.). *Middlesex:* Upper Norwood (S. Stevens). *Sussex:* Near East Grinstead (M. Burr). *Essex:* Near Epping, rare (H. Doubleday); near Colchester (W. H. Harwood). *Suffolk:* Beccles, one (C. Morley). *Hampshire:* Bournemouth (R. C. Bradley). *Guernsey:* Two (W. A. Luff). *Sark:* (W. A. Luff).

FORTSIMOL T.A DOCKYARD. 26/7/55.

21. Æschna cærulea, Ström.

(Plate XV.)

Synonymy.

Æschna cærulea, Ström, Nye Saml. af K. Danske Vid. Selsk. Skriv. ii. 90 (1783). *Æschna borealis*, Zett. Ins. Lapp. 1040 (1840); Selys, Rev. Odon. 119 (1850); McLach. Cat. Brit. Neur. 15 (1870). *Æschnia borealis*, Hag. Ent. Ann. 52 (1857). [*Libellula squamata* (?) Müll.

Faun. Ins. Fridr. 62, n. 546 (1764)]. *Æschna squamata* Kirby, Syn. Cat. Neur. Odon. 87 (1890).

Ström's description.

Libellula (cærulea) alis aqueis, corpore atro, maculis ceruleis.

This short Latin diagnosis is followed by a more particular description in Danish. (H. Ström, Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrivter ii., p. 90, n. 129, 1783).

[Kirby, in his Catalogue of the Neuroptera Odonata (1890), refers the *Æschna squamata* of Müller to this species. Müller says of it: *Libellula squamata*, alis albidis puncto marginali lutescente: lineis thoracis quatuor cæruleis. (Faun. Ins. Fridr., 1764.) Two years later he describes the insect more fully: "Facies fusca, albo-variegata. Oculi fusci. Thorax fuscus, lineis utrinque 2 albo-cæruleis. Pedes nigro-fuscis, squamula ad basin posteriorum alba. Abdomen cylindricum, fusco albo nigroque mire mixtum, subtus fuscum. Medio Septembris. (Nov. Act. Acad. Leopold.-Carol, 1766.) This description might apply to several species of the genus *Æschna*, but scarcely to this, which does not appear to occur in Denmark, and where, too, from the nature of the country we should hardly expect it. Further, in Scotland it appears to be over by the end of July, whereas Müller gives as the date for *squamata* the middle of September, when several Æschnas are certainly on the wing, but not *cærulea*. Of course, Zetterstedt's name, *borealis*, bestowed by him on the insect in his "Insecta Lapponica," published in 1840, must yield priority to Ström's. He appears to have been unaware of Ström's works when he published the description. It does not seem necessary to discuss the claim of Harris' *coluberculus* (1782) to belong to this species; but should anyone feel curious about the identity of the insect so named by him, he will find the case discussed in De Selys' "Revue des Odonates," p. 122].*

Size.

Length of Male, 66·5mm.; expanse of wings, 86mm. to 87mm. Length of Female, 58mm. to 64mm.; expanse of wings, 78mm. to 85mm.

* For a full treatment of the synonymy of this species, see R. McLachlan's article in E. M. M., 1898, p. 226.

Male Imago.

Face. Labrum dark brown, especially at margin; labium yellow, margins brown; rhinarium blackish; frons and nasus dull yellow, separated by a thin black line, on the upper surface of vertex a crescentic black mark, joined by a neck to the black line in front of the black vertex. *Eyes* blue, in contact but a short distance. *Thorax* downy, brown, two small blue marks in front, and two irregular blue lines at sides; sutures between the various parts black; projections at the attachments of the wings and between them chiefly blue. *Wings* hyaline, costal nervure yellowish-brown, others black; meshwork of cells fine; anal angle of hind-wings pointed; anal triangle enclosed by strong nervures, and divided into two cells. *Pterostigma* nearly black, 4mm. long. *Accessory membrane* triangular, cinereous.. *Legs* black. *Abdomen* swollen at second segment, much contracted at third, about the same width from fourth to end; the auricles on the second segment have three teeth below; basal segments downy; colour of abdomen dark brown, inconspicuous on account of the great development of the blue spots; first and second segments almost entirely blue; from 3 to 7 with six spots, three on each side of the mid-dorsal line, the middle pair being sometimes divided; 8 and 9 have four, and 10 two. Upper *anal appendages* short, black, blunt, with a line of hairs internally; near the apex of the median carina five or six teeth; and a tubercle near the base below; lower one half the length of upper, triangular, cut square at apex.

Female Imago.

Blue *colour* of a whiter or more lavender tint than in the male. *Pterostigma* brown; a little over 4mm. long. Anal angle of hind-wings rounded. *Ovipositor* and valves reaching just beyond the ninth segment. *Anal appendages* small, lanceolate, rather pointed. The shape of the abdomen is more like that of the male than is the case with the other British Æschnas.

Immature Colouring.

The lately disclosed male is of a general pale lilac tint instead of blue, and then more closely resembles the female.

Variation.

Great stress was at one time laid on the absence of bifurcation in the subnodal sector brought forward by De Selys ("Revue des Odonates," p. 122)—" . . . cette dernière est la seule (avec l'*Æ. irene*) parmi les Libellules d'Europe, dont le secteur subnodal n'est pas bifurqué sous la ptérostigma." This character has, however, been found not always to hold, and Mr. McLachlan thus sums up the case*: "That the upper branch of the furcation (when present) is perhaps never in the solid condition usual in *Æschna*; that it is often rudimentary, and that it is often absent in some of the four wings; but in all the specimens in my collection I do not find one in which there is not an indication (at least) of furcation, sometimes only on one side, sometimes in the anterior and not in the posterior. It

* E. M. M., 1889, p. 273.

is useful as a secondary character that should be taken in conjunction with others."

Date.

Judging by the accounts of the occurrence of this species in Perthshire, June is *the* month for it, though no doubt it would not be over by July.

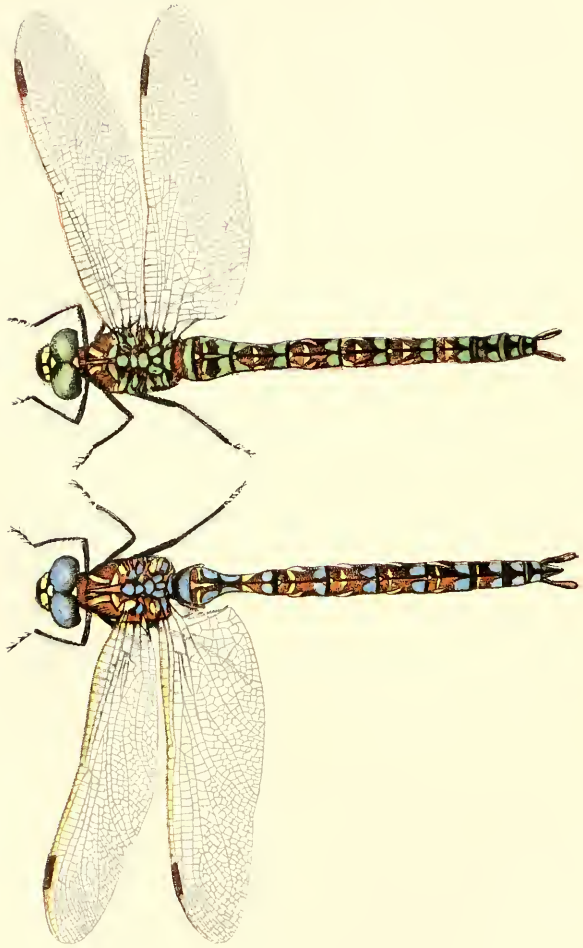
Habits.

In the Breadalbane locality, Mr. K. J. Morton notes that it occurred singly in 1895 over a considerable area, and especially affected the sunniest glades and openings, both in the little birch woods which mark the course of the burns down the hill-sides, and in the larger woodlands on the lower ground. It is a sun-loving thing, only flying freely when the weather is really warm; it is fond of basking on light-coloured stones, but when so resting is shy, and flies off at once if any attempt is made to approach it. While the greater number of examples were seen at the comparatively low altitude of 500ft. or 600ft., the species was also met with on the "moss-hags" around a peaty tarn at an elevation of about 1700ft. Mr. Morton says that he has no hesitation in expressing the opinion that its breeding-places are such mountain tarns, whence the insects scatter themselves sporadically over the glens in search of shelter, warmth, and food.* Mr. McLachlan speaks of those he took at Rannoch in 1865, as being on the steep fern-covered face of rocky hills, where their capture was most difficult. They never appeared to frequent the

* E. M. M., 1895, p. 260.

flat ground or moors.* In the same locality, in 1889, Messrs. Morton and King found that they frequented the roadsides and open swampy places near the Black Wood.† Mr. Porritt, in 1898, speaks of the species as occurring about the Black Wood, always *away* from water, flying over the heaths and heathery portions of the wood in the bright sunshine; not a single one was seen over the loch, or the locken above the wood, nor even about the smaller pools. He is inclined to think that the species may breed in the wet mossy ground, and not in the pools.‡ Mr. Briggs says that *cærulea* flew in the little open spaces in the Black Wood, rarely wandering into the open moor. These open spaces contain little permanent pools fed by natural drainage, and in these, no doubt of much greater magnitude in the winter, *cærulea* is probably bred. In its haunts are marshy places and deep holes and gullies, interspersed with hillocks covered with very high heather and fallen trees, rendering collecting difficult and active pursuit positively dangerous. In such localities it is fond of settling on stumps, or among the whitened boughs of a dead and fallen tree, where it is practically safe from the net, or on stones and similar basking places, where it is very shy. In the afternoon it frequently settled on fir-trunks in the manner noticed of its congeners, *juncea* and *grandis*, in the *Entomologist*, vol. xxvii., p. 350. Mr. Briggs mentioned how one, with a misplaced confidence, actually settled on his face; while on one occasion a male made the great mistake of settling on the breast of Mr. Morton's coat and looking him in the face.

* E. M. M., 1865, p. 117. † E. M. M., 1889, p. 383.
‡ Entom., p. 87, 1899.



Æschna juncea
(nat. size).

Distribution.

This northern and Alpine Dragonfly has at present been recorded in the British Isles only from the Rannoch and Breadalbane districts of Perthshire. Previous to 1865 its claim to a place in the British fauna rested on a single specimen taken in the north of Scotland by Mr. Wilson, and by him given to De Selys, as stated in the "Revue des Odonates," p. 121. In the beginning of June, 1865, however, Mr. McLachlan took two males and a female flying over steep and rocky banks near Camachgouran, on the south of Loch Rannoch. In the Black Wood and on the north side of the loch during the week ending June 22, 1889, Messrs. Morton and King took two males and three females; while in June, 1895, the former was fortunate enough to discover a more southerly locality in the Breadalbane district, and there to capture several specimens. It is probably present in the intervening country between these two districts, and perhaps in other localities also. It is satisfactory to note that the species at Rannoch, in 1898, on the occasion of a special visit by Messrs. King, Porritt, Briggs, and Morton, between June 7 and 21, was common during the second half of the period.*

22. Æschna juncea, Linn.

(Plate XVI.)

Synonymy.

Libellula juncea, Linn. Syst. Nat. i. 544, n. 10 (1758); Linn. Faun. Suec. 374 (1761). *Æshna juncea*, Steph.

* For a new locality, see Addenda.

Illustr. Brit. Ent. Mand. vi. 84 (1835); Evans Brit. Lib. 21, pl. 11, f. 2 (1845). *Æschna juncea*, Selys Mon. Lib. Eur. 106 (1840); Selys Rev. Odon. 116 (1850); Hag. Neur. N. Amer. 120 (1861); McLach. Cat. Brit. Neur. 15 (1870); Kirby Syn. Cat. Neur. Odon. 87 (1890). *Æschnia juncea*, Hag. Ent. Ann. 53 (1857). *Lib. quadrifasciata*, var. e, *ocellata*, Müll. Nov. Act. Acad. Leop.-Carol. 61 (1764). *Lib. ocellata*, Müll. Nov. Act. Acad. Leop.-Carol. iii. p. 125 (1767). *Æschna ocellata*, Hag. Syn. Lib. Eur. 54 (1840). *Æschna rustica*, Zett. Ins. Lapp. 1040 (1840). *Æschna picta*, Charp. Lib. Eur. 112, t. 20 (1840). *Æschna caucasica*, Selys Rev. Odon. 300 (1850). *Æschna propinqua*, Scudd. Proc. Bost. Soc. N.H. x. 215 (1866).

Linnæus' description.

L. alarum membranula accessoria nigricante, thorace lineis sex flavis, abdomine ad basin attenuato. . . . Alarum posticarum membranula baseos nigricans in hac specie, at in antecedenti (*i.e.*, grandis) alba. (C. Linnæus, "Systema Naturæ," ed. x., tom. i. 544, n. 10, 1758.) . . . *LIBELLULA juncea* alarum membrana accessoria nigricante, thorace lineis sex flavis, abdomine ad basin attenuato. (C. Linnæus "Fauna Suecica," p. 374, n. 1468, 1761.)

Size.

Length of Male, 73·5mm. to 76mm.; expanse of wings, 94·5mm. to 99mm. Length of Female, 68mm. to 73·5mm.; expanse of wings, 93mm. to 97mm.

Male Imago.

Face yellow; labium orange, edged with dark brown; labrum edged with dark brown, both before and behind;

rhinarium chiefly dark brown; a black line along the suture between nasus and frons; a black crescent on the top of the frons, joined by a stem to the black line in front of the eyes. Top of vertex yellow. *Eyes* blue, in contact for a long distance; behind the eyes a triangular yellow spot. *Prothorax* dark, yellowish behind. *Thorax* dark brown; two narrow curved yellow stripes in front; two oblique ones on each side, rather narrow, yellow, edged with black lines; spots at the attachment of wings yellow; projections between them chiefly blue. *Legs* black, a little yellow at the base of the fore-legs below. *Wings* hyaline, in old specimens sometimes tinted with sepia; costa golden; other nervures black; anal angle of hind-wings strongly pointed. *Pterostigma* narrow, over 4mm. long, dark brown. *Accessory membrane* short, but broad; basal half white, hinder part ashy. *Abdomen* swollen at segments 1 and 2; auricles on the latter; much constricted at segment 3, thence to the end of almost uniform width; ground-colour dark brown, in neighbourhood of spots darker, sutures black; arrangement of spots much as in *Æ. cyanea*, but on segment 2 the mid-dorsal triangle is much reduced, and if it reaches beyond the middle of segment does so only as a line. The thin yellowish line of *Æ. cyanea* immediately behind the sutures generally appears in *Æ. juncea* as a small yellow dot; the large posterior spots are blue; the spots on the ventral surface are yellowish; on segments 9 and 10 are in each case *two* distinct blue posterior spots. Upper *anal appendages* dark brown, somewhat short and slender, with an internal line of hairs; lower appendage about two-thirds the length of upper ones, triangular, light brown with black border, rounded at tip.

Female Imago.

Eyes greenish. Stripes on front of thorax very narrow, or reduced to a point; projections between wings yellow. Anal angle of hind-wings rounded. *Pterostigma* russet, 5mm. in length. *Abdomen* but little constricted at segment 3; spots that were blue in the male greenish-yellow. *Anal appendages* of moderate length, brown, leaf-like, with a black median carina, somewhat rounded at tip. *Ovipositor* as long as segment 9, curved, pointed, but shorter and much less conspicuous than in *Æ. cyanea*.

Hybrid.

At Rannoch, in June, 1898, Mr. Porritt relates that a curious *Æ. juncea* was taken, so much like a *cærulea* that it may be a hybrid, especially as no other *juncea* appeared to be out, the date being, of course, early for the species. It may be worth noting that near Bournemouth, on August 15, 1895, the author took an *Æ. juncea* flying on intimate terms with a male *Æ. cyanea*.

Immature Colouring.

In reaching maturity there seems to be much the same series of colour changes as is to be found in the case of *Æ. cyanea*, the next species.

Variation.

Besides considerable inconstancy in the size of the insect, there is, as De Selys points out in the "Revue des Odonates," p. 118, great variation in the size of the anal appendages of the female.

Distinction from Æ. cyanea.

To differentiate this species from *Æ. cyanea* it will be sufficient to notice the following three points: (1) The greater length of the pterostigma; (2) the golden costa; (3) the divided dorsal blue spots on segments 9 and 10.

Oviposition.

On one occasion late in August a long time was given to trying to catch a female which was continually dipping the tip of her abdomen below the surface of a pond on Ockham Common, evidently by this means depositing eggs, though in what manner was not seen, in the shallow water, about 1ft. deep, in a corner of the pond containing a bed of dry *Equisetum*. On approaching almost within reach she moved off a few yards and recommenced ovipositing as before. On returning later she (or possibly another) was still there, but soon fell a prey to the net as she was resting apparently with her wings on the surface of the water and her body submerged. A week or two later, in September, on Esher Common another was taken while ovipositing by repeatedly dipping her abdomen in the water in a similar manner.

Egg.

Length 1·5mm.; breadth nearly or quite a quarter of the length; cylindrical, inclined to spindle-shaped, with the tip and pedicel lighter, or more transparent, than the body. [Extracted from the dead body of a female

taken on Esher Common, September 15, 1896.] (Fig. 4, No. 1.)

Nymph.

Length, 44mm.; breadth, 8mm. Very similar to *Æ. cyanea*, a little shorter. *Processes* strikingly different. Anterior only half as large as posterior and much smaller (Fig. 19, No. 4). Granulation, color of legs, body, and appendages as in *Æ. cyanea*. The lateral appendages are more slender and more pointed, and the hind angles of occiput more rounded than in *Æ. grandis*. (L. Cabot, "Immature State of the Odonata," Part II. Cambridge, U.S.A., 1881.) On reference to Cabot's figures of the side view of *Æ. cyanea* and *Æ. juncea* we find a striking difference, especially in the distance through from dorsal to ventral surface, the distance in the case of *Æ. juncea* being very small.

Date.

Unlike the last this is one of the later Dragonflies, appearing on the wing about midsummer. I have not myself taken one before August. Thence it occurs till the very end of September.

Habits.

Though sometimes seen away from the water in the openings of a wood, the habit of these insects seems to be to hawk backwards and forwards or round and round in the sunshine over the reeds or along the margin of a pond, settling occasionally, especially if the sun disappears for a time. To make a capture is

usually a very difficult matter, and often, after watching their evolutions for an hour or more, not one may be taken. The best chance, perhaps, is to stand like a statue beside a bush or clump of reeds near their line of flight in the hope of one being thrown off its guard and approaching near enough to be struck at. On one occasion, if not more, late in the season this species had a propensity for settling in the sun on the trunks of the firs which fringe the margin of the pond on Esher Common, and then was very difficult to see. While so settled it was very restless and could scarcely be approached from the front without being startled from its perch, though this was not the case if an attempt to reach it was made from behind the tree. Mr. J. Arkle has seen this insect on the wing at 7.0 p.m.*

Distribution.

This Dragonfly seems to be well distributed throughout the British Isles, and is certainly not confined to the north as was at one time thought. Perhaps it will be found to have a preference for fir-woods. Localities are: *Inverness-shire:* Strathglass, Insh, and Loch-an-Eilan (J. J. F. X. King); Aviemore (K. J. Morton). *Argyll-shire:* Dalmally (J. J. F. X. King). *Perthshire:* Breadalbane district (K. J. Morton); Rannoch (G. T. Porritt). *Lanarkshire:* Carluke district (K. J. Morton). *Westmoreland:* Langdale (J. J. F. X. King). *Lancashire:* North (J. Arkle). *Yorkshire:* Sandburn (G. T. Porritt). *Cheshire:* Delamere Forest (J. Arkle). *Carnarvonshire:*

* Entom., 1897, p. 70.

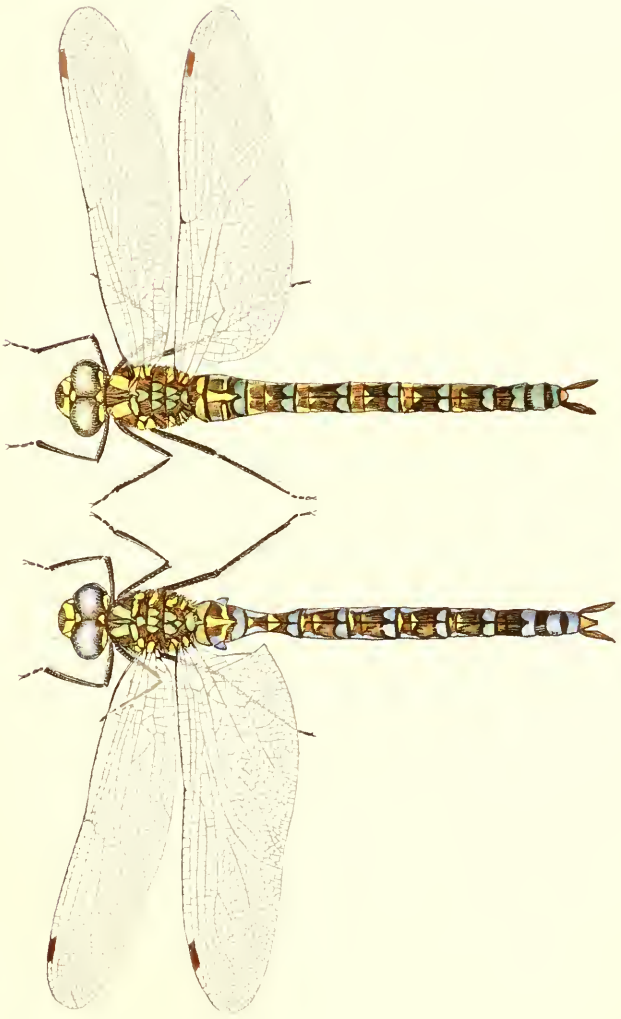
Penmaenmawr (G. T. Porritt). *Warwickshire:* Sutton Park and Sutton Coldfield (R. C. Bradley). *Huntingdonshire:* Whittlesea Mere (Stephens, *teste* De Selys). *Hertfordshire:* Chipperfield Common (J Arkle). *Berkshire:* Near Bagley Wood, near Oxford (A. H. Hamm). *Hampshire:* Near Bournemouth (W. J. L.). Hern Common (R. McLachlan). *Surrey:* Ockham Common and Esher Common (W. J. L.); near Elstead (E. B. Bishop); Weybridge (J. E. Tarbat). *Ulster:* Glasslough, Co. Monaghan (K. J. Morton); Armagh (J. J. F. X. King). *Leinster:* Waterston (J. J. F. X. King). *Munster:* Skibbereen, Co. Cork (J. J Wolfe); Muckross (J. J. F. X. King). *Connaught:* Kip and Shindilla Laoghs, Castlekirk, and Mackree Castle (J. J. F. X. King).

23. Æschna cyanea, Müll.

(Plate XVII.)

Synonymy.

Libellula cyanea, Müll. Faun. Ins. Fridr. 61, n. 541 (1764). *Æschna cyanea*, Selys Rev. Odon. 115 (1850); McLach. Cat. Brit. Neur. 15 (1870); Kirby Syn. Cat. Neur. Odon. 89 (1890). *Æschnia cyanea*, Hag. Ent. Ann. 53 (1857). *Libellula anguis*, Harr. Expos. Eng. Ins. 78, t. 23, f. 4. *Lib. grandis*, Don. Brit. Ins. v., t. 166 (1796). *Æshna grandis*, Panz. Schaef. Ic. ix. (1804). *Æshna maculatissima*, Latr. Hist. Nat. Crust. Ins. xiii. 7 (1805). *Æschna maculatissima*, Charp. Hor. Ent. 34 (1825); Steph. Illustr. Brit. Ent. Mand. vi. 83 (1836); Selys



Æschna cyanea

(nat. size).

Mon. Lib. Eur. 108 (1840); Evans Brit. Lib. 21, 11, f. 1 (1845). *Æschna juncea*, Charp. Lib. Eur. 103, t. 23 (1840). *Libellula varia*, Shaw, Gen. Zool. vi., 242, t. 80 (1806). *Libellula cœca*, Sulz. Kennz. d. Ins., t. 17, f. 101 (1761).

Müller's description.

Libellula cyanea alis albidis, puncto marginali nigro: lineis sex thoracis sulphureis. (O. F. Müller, "Fauna Insectorum Fridrichsdalina," p. 61, n. 541, 1764.)

Size.

Length of Male, 74mm; expanse of wings, 102mm. to 104mm. Length of Female, 71mm. to 74·5mm.; expanse of wings, 106mm. to 110mm.

Male Imago.

Face greenish-yellow; labium orange-yellow; margin of labium and labrum dark brown; rhinarium brown or yellowish; suture between nasus and frons a fine dark brown line; on top of frons a triangular black spot connected by stalk to the black line in front of eyes; top of vertex yellow. *Eyes* blue, in contact for a long distance; behind eyes a lengthened triangular yellow spot. *Prothorax* small, brownish-black, pale yellow in places. *Thorax* dark brown, two large oval greenish-yellow spots in front, two broad yellow oblique ones with other yellow markings between them on sides; spots at attachment of wings and projections between them greenish-yellow. *Legs* dark brown-black, with the underside of fore femora yellowish. *Wings* transparent, generally with a very pale sepia suffusion, especially in old specimens; hind-wings rather sharply pointed at

anal angle; costal margin brown; nervures black. *Pterostigma* black, fairly wide, 3mm. long. *Accessory membrane* small, pale in front, darker behind. *Abdomen* swollen at first and second segments, constricted at middle of third, then fairly uniform to the end; ground-colour dark brown, darker in neighbourhood of spots, sutures black; first segment, hind margin green, sides yellow; second, a yellow mid-dorsal lengthened triangle, an interrupted yellow streak across middle, along hind margin four large connected green spots, auricles and sides of fore part of segment blue; segments 3 to 7 with two large green spots on dorsal surface near hind margin separated by median carina, nearer the front margin two smaller triangular ones, more yellow, also separated by carina, a basal transverse yellowish-green line, and on the sides two basal blue spots separated by a black line; the eighth segment has two small lateral basal spots on each side and a pair of large blue dorsal ones at the posterior end of the segment; 9 and 10 have each *one* large unbroken posterior blue spot; on ventral surface are two large basal blue spots on the middle segments. *Anal appendages*, upper spreading at middle, surface oblique, rounded at end, and terminating with an incurved sharp point; a yellowish streak down the upper surface; lower rather long, sharply triangular, slightly truncated at tip.

Female Imago.

Face yellow, with an orange tinge. *Eyes* greenish. *Pterostigma* brown. Anal angle of hind-wings rounded. *Abdomen* stout; but little constricted at third segment; none of the spots become blue—they only reach yellowish-

green. *Anal appendages* of only moderate length, lanceolate, with a black carina along upper surface. *Ovipositor* long, curved inwards, reaching beyond the ninth segment.

Immature Colouring.

At first the ground-colour is rather light brown, and the spots are yellow. The latter change through green to blue, while the former becomes darker. The pterostigma is at first yellow.

Egg.

"Pale yellow, oval-cylindrical. A specimen measured $\frac{1}{16}$in. in length and $\frac{1}{30}$in. in breadth. Under the microscope the surface is seen to be finely marked with uniform delicate reticulations, not unlike the facets of the creature's wonderful eyes. Each egg has a very short pedicel at one end." (C. J. Watkins, "Nat. Journal," 1896, p. 145.)

Nymph.

Body without hairs, but granulated, elongated, constricted somewhat behind thorax, general ground-color dark sepia; length about 46mm., breadth 9mm. *Head* flat, pentagonal, 8·75mm. wide. *Vertex* but little raised; on front edge of *frons* a pale line. *Antennæ* seven-jointed, basal two short and swollen, distal five slender; third joint long, fourth short, seventh pointed. *Mask* extending quite to the insertion of the mid-legs, at base half the width of the front margin; middle lobe cleft and produced in a very obtuse angle; palpi cut straight at ends, which internally are produced very

slightly into hooks; movable hook sharp and slender. *Eyes* large, situated at the fore corners of the head, somewhat spherical, with a projection backwards towards the middle line of the head. *Occiput* rough, rather large, separated from eyes by a curved line; lateral margins pale and sloping backwards; a but little raised median carina, and on each side of it a smooth spot; hind margin concave. *Prothorax* about as broad as the middle of occiput, swollen somewhat, pale at sides. *Leg-base-processes* blunt, rough, enclosing a little more than a right angle, posterior a little the longer (Fig. 19, No. 5). *Meso-thoracic spiracles* exposed, dark. *Thorax* mottled at sides. *Legs* rather stout and fairly long, first pair about 16mm., mid- 18mm., hind- 23mm.; femora with two dark rings, also indicated on tibiæ. *Wing-cases* about 9mm. long. *Abdomen* enlarged gradually to the seventh segment, then contracting a little more rapidly to the end; a mid-dorsal whitish line in the basal half of each segment as far as the seventh or eighth, the ground-color darker on each side of it, and containing a fine black oblique streak with a black spot behind it; on each side of most of the segments two more black spots and two smooth patches; nine and ten are less ornamented; the whole of the abdomen above is more or less mottled with various shades of brown; no dorsal spines; lateral spines on segments 6 to 9. Upper *anal appendage* notched at tip; laterals about half length of lower ones, pointed; lower ones triangular, pointed, a little longer than upper one. *Female valves* long, reaching to the tenth segment. [Chiefly from an empty nymph-case of a female, from which the imago was bred.] *Male*

projection conical, rather enlarged at base, shorter than lateral appendages. *Genital parts* of the male indicated, those of the female extending somewhat beyond the ninth segment. (Cabot.)

Emergence.

The disclosure of the imago from the nymph-case agrees very closely with the method of procedure described for *Libellula quadrimaculata* (see page 112).

Date.

About the first day of July sees this Dragonfly upon the wing, and from that date it flies during the summer, and well into the autumn, the latest date with which I am acquainted being October 24, 1897, when one was taken in a gutter in Kingston-on-Thames.

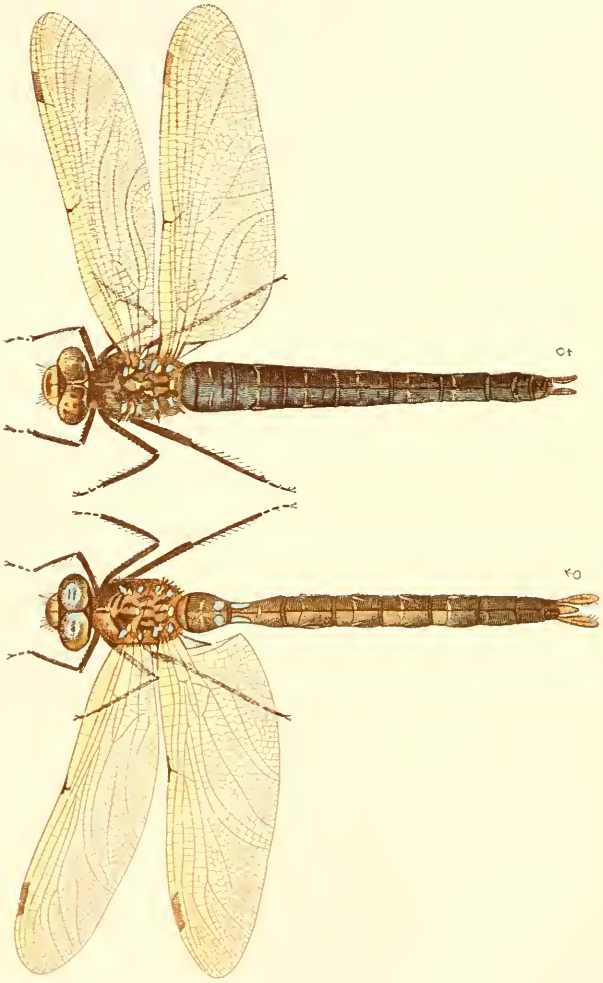
Habits.

Though sometimes seen flying over the water, where it is difficult to catch, this insect is oftener met with along hedgerows and lanes, where it sometimes for a long time flies backwards and forwards over a very restricted range. On such occasions, notwithstanding its rapid, powerful flight, it is usually possible with patient watching to make a capture. When once startled, however, it usually soars away out of sight, to return very possibly, however, to the same spot a little later. On one occasion, in Berkshire, I noticed an *Æ. cyanea* hawking along a hedge in this way, and presently saw it capture a butterfly (probably the Small Copper). After circling round it several times the Dragonfly secured its prey, and began wildly careering round, as

if rejoiced at its success. While thus engaged, a wing of the butterfly—or part of one—was let fall, and *cyanea* settled on the hedge, where it appeared to be further stripping its captive. Shortly after the Dragonfly was captured in its turn, when the body of the butterfly was found still between its jaws. But it is, of course, not at all an uncommon thing for one of the larger Dragonflies to capture a butterfly, whose wings it removes in a very workman-like manner.

Distribution.

In the British Isles, this Dragonfly seems to have a decidedly southern range. It has not been recorded from Ireland, and its occurrence in Scotland seems to need confirmation, though De Selys mentions it as present ("Revue," p. 116), and J. Mackay records it for Argyllshire ("Young Naturalist," Vol. viii., p. 180). Localities are: *Yorkshire:* York (W. C. Hey); Thorne (G. T. Porritt). *Westmoreland:* Langdale (J. J. F. X. King). *Cheshire:* Chester District (J. Arkle). *Huntingdonshire:* Monk's Wood (K. J. Morton). *Cambridgeshire:* The Fens (K. J. Morton); Ely (W. J. Ashdown). *Worcestershire:* Near Worcester (J. E. Fletcher); Bromsgrove (W. H. Bath); Trench Woods (R. C. Bradley). *Warwickshire:* Sutton Park (R. C. Bradley). *Devonshire:* (Evans Brit. Lib., p. 21). *Somersetshire:* Near Sparkford (W. J. L.). *Hampshire:* Bournemouth (W. J. L.). *Isle of Wight:* Near Ryde (S. A. Blinkarn); New Forest (Evans Brit. Lib., p. 21). *Berkshire:* Bagley Wood, near Oxford (W. J. L.); Reading (A. H. Hamm). *Surrey:* Purley (W. L. Distant); Kingston-on-Thames, Chertsey, Esher Common, and near Claygate (W. J. L.);



Æschna grandis

(nat. size).

Ockham Common (C. A. Briggs); The Borough (Mr. Redgeley); Weybridge (J. E. Tarbat). *Middlesex:* Cricklewood, Dudden Hill, Kingsbury, and Northwood (F. A. Walker); Brockley (H. J. Turner). *Sussex:* Battle (G. T. Porritt). *Kent:* Chattenden (H. J. Turner); Deal and Dover District (C. G. Hall); Folkestone (G. T. Porritt); Herne (Evans Brit. Lib., p. 21). *Essex:* Near Epping (H. Doubleday); Colchester (W. H. Harwood); Wanstead Park (F. A. Walker). *Guernsey:* L'Ancresse Common (F. V. Theobald).

24. Æschna grandis, Linn.

(Plate XVIII.)

Synonymy.

Libellula grandis, Linn. Syst. Nat. i. 544, n. 9 (1758); Linn. Faun. Suec. 373, No. 1467 (1761); Don. Brit. Ins. x., t. 337, f. 2 (1801). *Æshna grandis*, Steph. Illustr. Brit. Ent. Mand. vi. 83 (1836); Evans Brit. Lib. 20, pl. x., f. 2 (1845). *Æschna grandis*, Charp. Hor. Ent. 32, t. 1, f. 2 (1825); Charp. Lib. Eur. 114, t. 24 (1845); Selys Mon. Lib. Eur. 112 (1840); Selys Rev. Odon. 131 (1850); McLach. Cat. Brit. Neur. 15 (1870); Kirby Syn. Cat. Neur. Odon. 90 (1890). *Æschnia grandis*, Hag. Ent. Ann. 54 (1857). *Lib. quadrifasciata*, Müll. Nov. Act. Acad. Leop.-Carol. 61, n. 540 (1764). *Lib. nobilis*, Müll. Nov. Act. Acad. Leop.-Carol. 126 (1767). *Lib. flavipennis*, Retz. Gen. Spec. Ins. 57, n. 185 (1783).

Linnæus' description.

L. alis glaucescentibus, thoracis lineis quatuor flavis. (C. Linnæus, "Systema Naturæ," i., p. 544, n. 9, 1758). . . . *LIBELLULA grandis* alis glaucescentibus, thoracis lineis quatuor flavis. Libellula grisea, alis flavescentibus, thoracis lateribus lineis flavis, cauda diphylla. . . . *Descr.* Duo folia fusca lanceolata, in cauda *Abdomen* longum, angustum, rufo-fuscum, interdum albo maculatum. In *Thorace* lineolæ utrinque duæ, oblique transversales, flavæ; thorax alias abdomini concolor, hirsutus. *Alæ* flavescentes macula ferruginea. Est inter maximas. (C. Linnæus, "Fauna Suecica," p. 373, No. 1467, 1761.)

Size.

Length of Male, 70mm. to 76mm.; expanse of wings, 96mm. to 101mm. Length of Female, 69mm. to 76mm.; expanse of wings, 101mm to 104mm.

Male Imago.

Face yellowish-brown; labrum and labium of a more russet tinge; on the top of frons a darker brown crescent; vertex yellowish-brown. *Eyes* blue, in contact for a long distance; behind eyes a small yellow triangle. *Prothorax* brown. *Thorax* russet-brown, with two oblique yellow stripes on each side; a blue spot at the attachment of each of the wings. *Legs* rather dark brown. *Wings* suffused with saffron; all the nervures russet; anal angle of hind-wings pointed. *Pterostigma* russet, narrow, 3·5mm. long. Accessory membrane rather small, whitish. *Abdomen* rather swollen at first and second

segments (second with auricles), contracted at third, then fairly uniform to end; brown; two posterior dorsal spots on second segment, and basal ones on third; a lateral blue or bluish-yellow spot on the anterior part of each segment as far as the eighth; a transverse yellow streak on each of segments 2 to 8 interrupted by the median carina. *Anal appendages* brown; upper of moderate length, with a raised median carina, blunt at tip; lower triangular, about half length of upper ones, tip rounded.

Female Imago.

Eyes yellowish-brown, with a bluish glance. Anal angle of hind-wings rounded. *Pterostigma* 4mm. long. *Abdomen* stout at second segment, not contracted at third, but gradually tapering to the end of the seventh; eighth and ninth expanding, tenth contracting to tip; lateral spots yellowish; blue dorsal spots absent from segment 3. *Anal appendages* small, leaf-like, rounded at tip. *Ovipositor* almost crimson, pointed, much curved, as long as ninth segment.

Oviposition.

One or more females of this species were watched one fine morning in September, as they were ovipositing in the very shallow water close to the margin of the large pond in Richmond Park. This they accomplished by settling either on a floating weed, or on one that was but little out of the water, and then bending the tip of the abdomen so as to dip its extremity below the surface. It appeared to be done deliberately, as if the eggs were being carefully deposited, as no doubt was the case (Fig. 3, p. 14).

Egg.

Length about 1·5mm., breadth about ·3mm. Shape cylindrical, rounded at one end, pointed at the other. Colour yellowish. Contents granular or in oil-like globules. [Extracted from the body of a dead female caught in Richmond Park, September 11, 1898.]

Nymph.

Body without hairs, but granulated, elongated, constricted to a considerable extent behind thorax; colour dark chestnut-brown; length 40mm., breadth 8·5mm. *Head* rather flat, pentagonal, 9mm. wide. *Vertex* a little raised. *Antennæ* seven-jointed, two basal joints short and swollen, five distal ones slender; third long, fourth short, rest about equal, seventh pointed. *Mask* at hinge about half width of front border; middle lobe cleft, and produced very little in a very obtuse angle; palpi cut straight at ends; movable hooks sharp and slender. *Eyes* rather large, situated at fore corners of head, somewhat spherical, with a prolongation backward toward the middle line of head. *Occiput* fairly broad; curved line separating it from eyes, lateral margin sloping backwards, hind margin straight, median line but little raised, pale, on each side of it a smooth patch. *Prothorax* in centre, about as wide as middle of occiput, with a raised front margin; almost pointed in the middle of the hind margin; sides pale. *Leg-base-processes* rough, sharp-pointed, about equal, enclosing an acute angle, but not much less than a right angle; tip of anterior process turned outward a little. (Fig. 19, No. 6). *Meso-thoracic spiracles* exposed. *Legs* rather stout, fairly long; first pair about 14mm. in length, mid-

17mm., hind- 21mm.; femora obscurely ringed; tarsi much darker than the rest of the leg. *Wing-cases* broad, about 9mm. long. *Abdomen* enlarged gradually to sixth segment, then contracting rather rapidly to the end; a few dots, lines, and smooth depressions, corresponding very much with those on *Æ. cyanea*, but much less marked; no dorsal spines; lateral spines on segments 6 to 9, indicated on 5. Upper *anal appendage* about 1mm. shorter than lower ones, notched with a square-cut notch; laterals cylindrical, pointed, barely half length of inferiors; inferiors triangular, angular, longer than last two segments, sharp-pointed. *Male projection*, triangular, blunt, nearly as long as lateral appendages. [From a male specimen taken from the canal near Byfleet, which died before disclosing an imago, but with little doubt to be referred to this species. It agrees with Cabot's description, in this case a short one.]

Date.

Once seen on June 23; but the beginning of July is the usual time for the insect to appear. Thence it continues on the wing till about the middle of September.

Habits.

Though perhaps even more powerful on the wing than *Æ. cyanea*, and oftener seen near water, its habits are very similar to those of that species. When encountered hawking along a hedgerow or a lane, with care a capture is usually not difficult to effect; but if once disturbed and frightened, the insect will probably soar straight away and be seen again no more. It is not an uncommon

thing to see this species at rest on a bare wall in the sun. On one still afternoon, as a specimen of this Dragonfly was hawking about overhead, the stroke of its wings could be heard a dozen or more yards away. *Æ. grandis* frequently visits gardens even in towns, and there and elsewhere continues its evolutions till quite late in the evening, as has often been recorded—for instance: At Glasslough, Co. Monaghan, when nearly dark (K. J. Morton); near Chester, along a hedge, 9.0 p.m., on July 21 (J. Arkle); and Chester, at 7.0 p.m., on September 4 (J. Arkle). On the other hand, on August 8 one was seen on the wing as early as 7.45 a.m. It is voracious and fearless, and often preys on quite large insects, *Charæas graminis* and *Hydræcia nictitans* being two victims noticed at Glasslough.*

Migration.

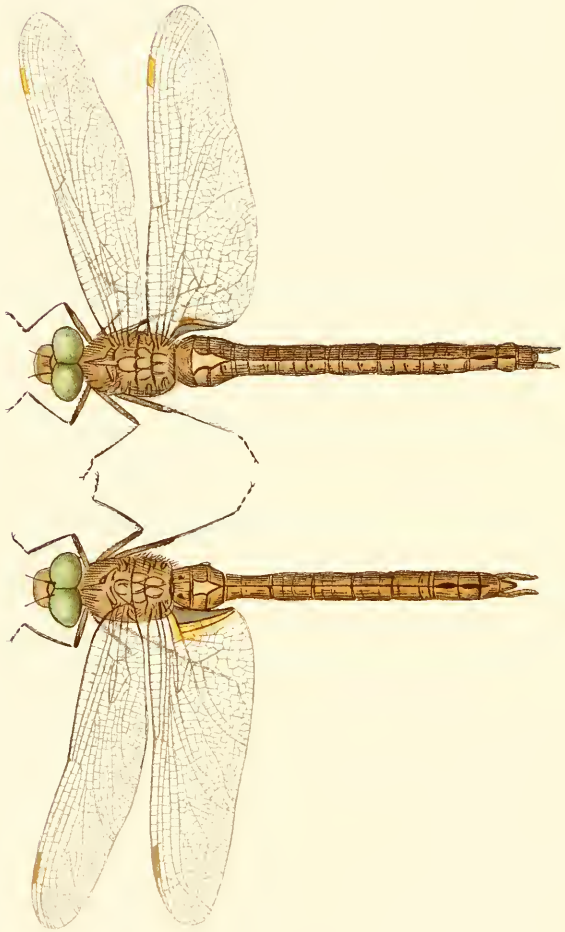
De Selys says in this connection: "Elle accomplit parfois de grandes migrations." ("Revue des Odonates," p. 131.)

Distribution.

The range of this species seems to be chiefly in the southern part of the British Isles. De Selys says: "dans les trois parties des îles Britanniques" ("Revue," p. 131), but I have seen no records for Scotland. *Lancashire:* Near Heaton, near Bolton (O. Whittaker); Marton Mere, near Blackpool (G. T. Porritt). *Yorkshire:* York (W. C. Hey). *Cheshire:* Chester District (J. Arkle). *Merionethshire:* Tan-y-bwlch (A. W. Imms). *Staffordshire:* (W. H. Bath, "Naturalists' Gazette," 1891, p. 43).

* E. M. M., 1892, p. 301.

PLATE XIX.



Æschna isosceles
(nat. size).

Warwickshire: Sutton Park and Sutton Coldfield (R. C. Bradley); Birmingham District (A. W. Imms). *Worcestershire:* Near Worcester (J. E. Fletcher). *Lincolnshire:* (Evans Brit. Lib. p. 20). *Huntingdonshire:* Monk's Wood (K. J. Morton). *Cambridgeshire:* Fens (K. J. Morton); Wicken Fen (W. J. Ashdown); West Wickham (H. J. Turner). *Norfolk:* Near Lowestoft (J. Prest). *Essex:* Colchester and near Clacton-on-Sea (W. H. Harwood); Wanstead Park (F. A. Walker); near Epping (H. Doubleday). *Hertfordshire:* (Evans Brit. Lib., p. 20). *Devonshire:* (Evans Brit. Lib., p. 20). *Hampshire:* Bournemouth (W. J. L.). *Berkshire:* Bagley Wood, S. Hincksey, and near Eynsham (W. J. L.); Reading (A. H. Hamm). *Oxfordshire:* Brighthampton (Mr. Stone's specimens in Oxford Museum). *Surrey:* Esher Common, Ockham Common, near Clandon, near Byfleet, and Richmond Park (W. J. L.); Bookham Common (C. A. Briggs); Kew (G. Nicholson); Weybridge (J. E. Tarbat). *Middlesex:* Cricklewood and Pinner (F. A. Walker); Brockley (H. J. Turner). *Kent:* Deal and Dover District (C. G. Hall). *Ulster:* Glasslough, Co. Monaghan, very common (K. J. Morton). *Leinster:* Waterston (J. J. F. X. King).

25. Æschna isosceles, Müll.

(Plate XIX.)

Synonymy.

Lib. quadrifasciata, var. *β. isoceles*, Müll. Nova Acta Leop.-Carol. iii. 125, n. 9 (1767). *Æschna isoceles*, Hag. Syn. Lib. Eur. 58 (1840); Kirby Syn. Cat. Neur.

Odon. 90 (1890). *Æshna grandis*, Lind. Opusc. Scient, iv. 160, n. 3, t. 4, f. 3 (1823). *Æschna chrysophthalmus.* Charp. Hor. Ent. 33, tab. i., f. 3 (1825); Charp. Lib. Eur. 116, tab. 25 (1840). *Æshna rufescens*, Lind. Mon. Lib. Eur. 27 (1825); Steph. Illustr. Brit. Ent. Mand. vi. 82 (1836); Evans Brit. Lib. 20, pl. x., f. 1 (1845). *Æschna rufescens*, Selys Rev. Odon. 129 (1850); McLach. Cat. Brit. Neur. 15 (1870). *Æschnia rufescens*, Hag. Ent. Ann. 54 (1857).

Müller's description.

Libellula isoceles alis albentibus: abdomine rufo-fusco, basi dorsi triangulo flavo . . . Alæ in mare albidæ, inferiores quidem ad basin incurvatam lutescentes, in fœmina alæ omnes subflavescentes. Lineæ thoracis laterales obsoleto-flavæ. (F. F. Müller, "Nova Acta Leop.-Carol." iii., p. 125, n. 9 (1767).

[Müller places this insect under *Lib. quadrifasciata*, and questions whether it and others are varieties or species. Its being found to be a species gives priority to Müller's name, the spelling of which needs altering to *isosceles*.]

Size.

Length of Male 67mm.; expanse of wings, 91mm. Length of Female, 70mm.; expanse of wings 94mm. [From two specimens in Mr. McLachlan's cabinet.]

Male Imago.

Head, thorax, and abdomen of a bright sienna-brown; *face* of a yellowish tinge, upper lip margined with brown. *Eyes* green. *Thorax* with two oblique yellow lines on each side; no dorsal spots or lines in front; attachments of the wings not blue, but yellow. *Legs* black, with base of femora brown. *Wings* with a

slight brownish tinge; nervures blackish; base of the wings saffron; anal angle of hind-wings pointed. *Pterostigma* brown, about 4·5mm. in length. *Accessory membrane* large, blackish. *Abdomen*, first and second segments swollen, third constricted, then of nearly the same width from four to the end; a mid-dorsal black keel; on the middle of the upper surface of the second segment a large yellow triangular spot; two transverse black streaks, interrupted by the yellow triangle on segment 2; a transverse black streak and two black dots on segments 3 to 7; a broad, longitudinal, mid-dorsal line on segments 8 and 9; the sutures of the segments black. Upper *anal appendages* brown, hairy, long, leaf-like, a very obtuse point near the base below; lower appendage about half the length of upper, brown, triangular.

Female Imago.

Colour and markings much as in male. *Abdomen* but slightly constricted at third segment. *Anal appendages* shorter than in male, brown, slender. Saffron at base of wings not so marked as in male. Anal angle of hind-wings rounded.

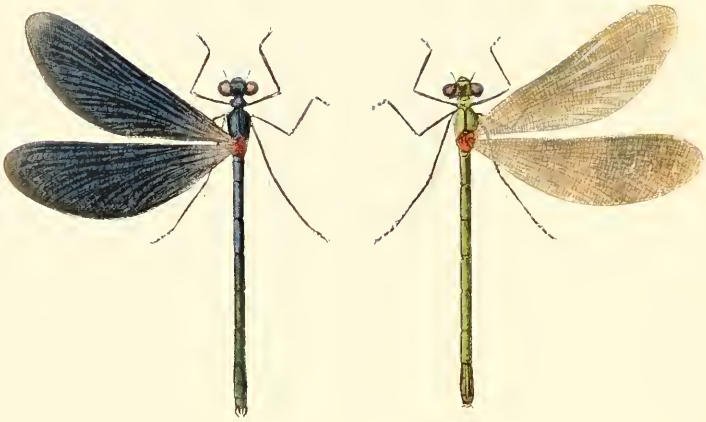
Variation.

De Selys speaks of specimens with very brown wings as varieties.

Nymph.

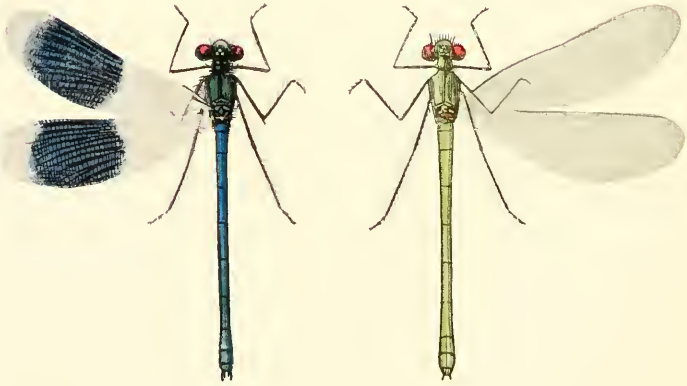
Length, 40mm. to 44mm.; breadth, 9mm. Stout. Head large, flat, broader than long. Eyes large, very prominent, separated from occiput by nearly straight

line. Occiput short, hind angles rounded and with polished bands on upper side ; a polished spot on each side of the median line ; hind border notched. Ocelli indicated. Anterior portion of vertex semicircular. Antennæ short, not extending beyond the eyes ; seven-jointed, third joint longest. Mask extending between middle legs, stout ; length greater than breadth ; enlarged gradually forward ; middle third somewhat produced, cleft in middle, with comb of hairs. Palpi broad, straight, cut square at end and produced only slightly in end hooks, finely denticulated. Movable hooks sharp and bent, thin, just reaching the base of their opposite. Prothorax not as broad as occiput, hind border rounded. Processes enclosing an acute angle, anterior one half length of posterior, both sharp. (Fig. 19, No. 7.) Legs rather slender, hind-legs longest, extending to eighth segment ; femora somewhat arcuated ; two faintly-marked pale rings on lower portion of femora. Wing-cases extending to fourth segment. Abdomen stout, very convex above, tapering from the middle to the tip, smooth ; two parallel dark dorsal bands best defined at beginning of segments. Lateral spines on segments 6 to 9, strong, last shorter than segment 10. Appendages sharp, long as the last two segments ; lateral inferiors longest, lateral superiors two thirds the length of middle, middle nearly or quite straight at tip. Male projection stout, blunt, triangular, angular, half length of lateral superior appendages. Female ventral valve reaches end of segment. (L. Cabot, "The Immature State of the Odonata," Part II. Memoirs of the Museum of Comparative Zoology at Harvard College, U.S.A., 1881).



Calopteryx virgo

(nat. size).



Calopteryx splendens

(nat. size).

Date.

In Belgium at the end of May and in June. It flies at the same time as *Anax imperator*. (De Selys.)

Distribution.

This fine Dragonfly has a very restricted range in this country. It is only found in the Fens, and, till one was taken about five years ago, it was thought to have become extinct even there. McLachlan says that it used to be common near Yarmouth, while Bath says that it was formerly taken at Halvergate, in Norfolk, and Whittlesea Mere, in Cambridgeshire. The only dated records I possess are two specimens near Norwich in 1871 (C. G. Barrett), and one in the Fens in 1893 (W. H. Bath). The fact of its coming to light again after being unnoticed for so long should encourage Fen collectors in the early summer (perhaps early June) to make an attempt to place this insect in a more stable position on our list.

26. Calopteryx virgo, Linn.

(Plate XX.)

Synonymy.

Libellula virgo, Linn. Syst. Nat. i. 545, n. 17 (1758); Linn. Faun. Suec. 374, n. 1470 (1761). *Agrion virgo*, Charp. Hor. Ent. 4 (1825); Charp. Mon. Lib. Eur. 134, t. 31 (1840); Kirby Syn. Cat. Neur. Odon. 98 (1890). *Calopteryx virgo*, Steph. Illustr. Brit. Ent. Mand. vi.

79 (part) (1836). *Callepteryx virgo*, Hag. Syn. Lib. Eur. 61 (1840). *Calopteryx virgo*, Selys Rev. Odon. 134 (1850); Selys Syn. Cal. 13 (1853); Selys Mon. Cal. 43 (1854); Hag. Ent. Ann. 55 (1857); McLach. Cat. Brit. Neur. 15 (1870). *Lib. splendens*, Harr. Expos. Eng. Ins. 99, t. 30, f. 2 (1782). *Lib. splendeo*, Harr. Expos. Eng. Ins. 99, t. 30, f. 4 (f. 5 ?) (1782). *Calep. ludoviciana*, Steph. Illustr. Brit. Ent. Mand. vi. 79 (1836); Evans Brit. Lib. 19, pl. 7, f 3, pl. 8, f. 1 (1845). *Calept. xanthostoma*, Steph. Illustr. Brit. Ent. Mand. vi. 80 (1836). *Calept. anceps*, Steph. Illustr. Brit. Ent. Mand. vi. 80 (1836); Evans Brit. Lib. 19, pl. 9, f. 1 (1845). *Agr. colchicus*, Eichwald Reise Casp. Meere, i. (2) 272 (1837). *Agr. vesta*, Charp. Lib. Eur. 136, t. 32 (1840). *Callept. vesta*, Hag. Syn. Lib. Eur. 63 (1840). *Calept. hæmorrhoidalis*, Evans Brit. Lib. 19, pl. 8, f. 2, 3 (1845). *Agr. festiva* (var) Brullé Expéd. Morée. II. (i). 103, t. 32, f. 5, 6.

Linnæus' description.

L. alis erectis coloratis . . . (*α*). Libellula corpore sericeo nitido, alis luteo-fuscis margine immaculatis . . . (*β*). Libellula corpore sericeo nitido, alis viridi-cærulescentibus apice fuscis: margine immaculatis . . . (*γ*). Libellula corpore viridi-cæruleo, alis subfuscis: puncto marginali albo . . . (*δ*). Libellula corpore sericeo nitido, alis inaurato-fuscis: macula nigra. (C. Linnæus, "Systema Naturæ", tom. i., 545, n. 17 (1758) . . . Libellula *virgo* alis erectis coloratis . . . (*α*. Libellula corpore sericeo nitido: alis luteo-fuscis: margine immaculatis. DESCR. *Corpus* mediæ magnitudinis, e cæruleo nitens, sive atratum. *Alæ* luteo-fuscæ absque ullo puncto obscuro

ad marginem exteriorem alarum (β). Libellula corpore cæruleo nitido; alis viridi-cærulescentibus: apice fuscis; margine immaculatis. DESCR. *Alæ*, quæ etiam puncto marginali carent, nigro-cærulescentes: apice pallide fuscæ. *Cauda* unguiculata . . . (γ). Libellula corpore viridi-cæruleo; alis subfuscis: puncto marginali albo. DESCR. *Corpus* viridi-sericeum, nitidum, minime cæruleum. *Pedes* nigri. *Alæ* subfuscæ puncto marginali albicante oblongo. *Cauda* inermis. Hæc præcedentibus fœmina. *De Geer* . . . (δ). Libellula corpore sericeo nitido; alis inaurato-fuscis: macula nigra. DESCR. *Corpus* cæruleo nitidum. *Pedes* nigri. *Alæ* a medio versus apices cærulescente nigræ; ipsis apicibus aurato-fuscis; a medio alæ versus ejus basin color inauratus, nullum punctum marginale in hac. (C. Linnæus, "Fauna Suecica," pp. 374-5, n. 1470, 1761).

[Linnæus here has made varieties of individuals of different age, sex, and species, and so caused a considerable amount of confusion. (α) is an immature male of *C. virgo*. (β) is an adult male of the same species. (γ), as De Geer says, is a female of the same. (δ) appears to be an adult male, *C. splendens*.]

Size.

Length of Male, 45mm. to 47·5mm.; expanse of wings, 56·5mm. to 62mm. Length of Female, 43mm. to 46mm.; expanse of wings, 58·5mm. to 69mm.

Male Imago.

Head deep metallic blue; margins of labrum and labium blackish. *Eyes* ruddy, small, globular, distant. *Prothorax* small, blue. *Thorax* blue, sometimes with a greenish tinge; projections at insertion of wings, and between them yellowish. *Legs* long, slender, black.

Wings broad at centre; rich metallic blue, like the rest of the insect (deep brown in some lights); apex and base brown and somewhat transparent; meshwork fine. *Pterostigma* absent. *Abdomen* long, slender, cylindrical, deep metallic blue; a trifle swollen at eighth and ninth segments. *Anal appendages* black; upper rather long, spiny, flattened, and approaching posteriorly, turned slightly downwards; lower appendages shorter, flattened, approaching at tips, turned upwards.

Female Imago.

In the female the general ground-colour instead of being blue is deep metallic green, which on the hinder part of the abdomen changes to a decided coppery tint; a yellow mid-dorsal line extends along segments 8, 9, and 10, the tenth being keeled. *Wings* narrower than in the male; in general russet, costal margin green. *Pterostigma* white, small, elliptical, about 1mm. long. *Ovipositor* sharp, as long as the ninth segment, sheaths reaching to the end of the tenth. *Anal appendages* short, sharp-pointed, conical.

Immature Colouring.

In the *male* the wings are at first russet, much as in the female. Soon a smoky blue tint appears, and ultimately they become deep blue. This change of colour was a cause of much confusion amongst the older writers. The *female* colouring is at first clear russet, but becomes somewhat darker with age.

Variation.

Unlike most British Dragonflies, *C. virgo* is subject to considerable variation. The chief forms are as follow:

α. The form of the male, in which the wings remain of a russet tint, and in which the meshwork of the wings is extremely fine, has been named *anceps* (Stephens) and *vesta* (Charpentier). It has on several occasions been mentioned as occurring away from water (*e.g.* E. M. M., 1871, p. 87 and 161 ; 1884, p. 274), which would lead one to suppose that it was very immature ; but still it may be that at times, and perhaps regularly in certain localities, the male never does assume the blue colouring to its wings ; in the latter case, the form would constitute a distinct race. That the blue pigment is at times undeveloped is certain, for the author has a specimen, taken in the New Forest, with the right fore-wing russet and the other three of the mature blue tint ; while the Rev. J. E. Tarbat has one with both fore-wings wanting the blue pigment.

β. Males with smoky wings are almost certainly always half mature.

γ. Often no russet colouring appears at the tip of the hind-wings of the male, and it varies much in extent at the tip of the fore-wings also.

δ. The wings of the female, the hind ones especially, are sometimes smoky ; but this is perhaps only a sign of age.

ε. Not an uncommon form of the female has the wings somewhat dark, especially the hind ones, while a much darker transverse band crosses the latter near the apex ; the meshwork of the wings is usually coarser. Perhaps age may again have a great deal to do with the dark colouring.

ζ. The wings of the female sometimes have a greenish tinge, causing them to resemble those of *C. splendens* to some extent.

η. The pterostigma of the female varies a little in size and distinctness.

Egg.

A *Calopteryx* egg is somewhat cylindrical, rounded at one end, and having a point, perhaps of attachment, at the other. It resembles Nos. 6 and 7 of Fig. 4.

Nymph.

It is difficult to separate the nymph of this species from that of its congener, *C. splendens*, described on p. 224, and illustrated at Fig. 37. The most reliable points of distinction appear to be the more slender caudal appendages, which are also of nearly equal length. In *C. splendens* the middle one is considerably shorter than the others. In *Science Gossip*, September, 1894, *C. splendens* is figured with the appendages unbanded ; but, as a matter of fact, there is little difference between the two species in this respect. The raised plate on the head, too, seems to fail as a distinguishing mark in the empty nymph-case ; perhaps, however, in the living nymph there may be sufficient difference in the head to help to separate the species. Two dorsal smooth marks on the segments of the abdomen are present in both species, but in neither do they touch the hind-margin of the segment. [A New Forest nymph-skin and some young nymphs, presumably of this species as *C. splendens* does not appear to exist in the Forest.]

Date.

In the New Forest I have taken this species on May 7, and also as late as August 18. On the first occasion it was probably just coming on the wing, and on the latter going over. These dates may fairly be looked upon as near the limits for the species. Mr. E. A. Fitch, however, reports it as present in hundreds near the source of the Essex and Suffolk Stour, on August 22, 1879, (Entom, 1879, p. 288).

Habits.

C. virgo flies slowly in an uncertain fluttering manner, like some of the weak-flying butterflies, along the edges of streams that are overgrown or fringed with bushes. Gorgeous objects the males appear when thus fluttering in the sunshine; but at rest on a bush, with their wings closed over their back, they are not easily seen. When immature, at which time the wings of the male may be without the blue pigment, they may usually be found away from the water (see E. M. M., 1871, p. 87 and 161; 1884, p. 274).

Distribution.

The following localities have been reported for *C. virgo: Perthshire:* (A. M. Rodger). *Cheshire:* Chester, banks of the Dee above Chester, and Eaton (J. Arkle). *Wales:* North (J. Arkle). *Flintshire:* Worthenbury (J. Arkle). *Merionethshire:* The banks of the Dee, and by wooded streams (J. Arkle). *Cardiganshire:* (J. Arkle). *Yorkshire:* Castle Howard (G. T. Porritt); near Wakefield, formerly (G. Parkin) *Worcestershire:* near Worcester and Trench Wood

(J. E. Fletcher); Wyre Forest (R. C. Bradley). *Warwickshire:* Sutton Coldfield (R. C. Bradley); Birmingham District (A. D. Imms). *Oxfordshire:* Brighthampton (Mr. Stone's specimens in Oxford Museum). *Cornwall:* Land's End (A. Ficklin). *Devonshire:* Lynmouth (C. A. Briggs). *Wiltshire:* Savernake Forest (F. A. Walker). *Hampshire:* New Forest (W. J. L.); Pamber Forest, near Basingstoke (A. H. Hamm). *Berkshire:* Windsor (F. A. Walker); Kennett, near Reading (A. H. Hamm). *Surrey:* River Mole, near Leatherhead (W. J. Ashdown); near Virginia Water (J. E. Tarbat); near Farnham and Puttenham Common (E. B. Bishop). *Sussex:* Horsham (H. J. Turner). *Essex:* Near Epping (H. Doubleday); near Colchester (W. H. Harwood). *Suffolk:* Near the source of the Stour (E. A. Fitch). *Ireland:* (De Selys, "Rev. Odon.," p. 138). *Guernsey:* (W. A. Luff).

27. Calopteryx splendens, Harr.

(Plate XX.)

Synonymy.

Libellula splendens, Harr. Expos. Eng. Ins. 99, t. 30, f. 1, 3 (1782). *Calopteryx splendens*, Selys Rev. Odon. 138 (1850); Selys Syn. Cal. 12 (1853); Selys Mon. Cal. 36 (1854); Hag. Ent. Ann. 55 (1857); McLach. Cat. Brit. Neur. 15 (1870). *Agrion splendens*, Kirby Syn. Cat. Neur. Odon. 97 (1890). *Libellula splendeo*, Harr. Expos. Eng. Ins. 99, t. 30, f. 5 (?) (1782). *Libellula virgo*, Linn. Syst. Nat. i., 545, n. 17,

var. δ (1758); Linn. Faun. Suec. 374, n. 1470, var. δ (1761). *Agrion virgo*, Fabr. Syst. Entom. 425 (part, 1775). *Agrion xanthostoma*, Charp. Hor. Ent. 5 (1825); Charp. Lib. Eur. 139 (1840). *Calepteryx virgo*, Steph. Illustr. Brit. Ent. Mand. vi. 79, vars. *a* and γ (1836); Evans Brit. Lib. 18, pl. 7, f. 1, 2. *Calopteryx ludoviciana*, Selys Mon. Lib. Eur. 131 (1840). *Callepteryx ludoviciana*, Hag. Syn. Lib. Eur. 64 (1840). *Agrion parthenias*, Charp. Lib. Eur. 137, t. 33 (1840). *Calopteryx ancilla*, Selys Syn. Cal. 13 (var.) (1853). *Calopteryx taurica*, Selys Syn. Cal. 13 (var.) (1853).

Harris' description.

Libellula splendens. Fig. 1. Measures nearly 2in. The *head*, *thorax*, and *abdomen* are of a most beautiful green. The *legs* are black. The *wings* are finely reticulated, and have in each a large dark brown cloud, about the size of a finger-nail, which in some directions appear (*sic.*) of a lovely deep blue. The *libella*, at Fig. 2, is only to shew a variation, or sport, of Nature (which, in the *libellas*, is common with her), as they are both of one species, and of the same sex. These are females. The *male* is seen at Fig. 3; it is entirely of a fine green, except the *legs*, which are black. The *wings* look like green gauze. (M. Harris' "Exposition of English Insects," p. 99, Tab. xxx., Figs. 1, 2, 3, 1782).

> [Here Harris has not only reversed the sexes, but Fig. 2 is a male *C. virgo*. Following this description is another of the insects which he names *splendeo*. It is as follows: "*Splendeo*. Fig. 4. Measures near 2in. The *head*, *thorax*, and *abdomen* are of a fine, deep blue green. The *wings* are of a tawny brown. The *male* at 5 is of a beautiful yellow green, having a white speck near the end of each wing. . . . These, and the former, on account of their brilliancy and richness of colours, are vulgarly called Kingfishers.

They frequent little rivulets, or ditches of running water, that are overshaded by bushes by bank sides." Fig. 4 is probably a male, as the white "speck" is not mentioned, and the appendages appear to be those of a male; the body, however, looks like that of a female. In the case of Fig. 5, the brown wings seem to point to a female *virgo*, but the description appears to suit a female *splendens*.]

Size.

Length of Male, 44·5mm. to 47·5mm.; expanse of wings, 56mm. to 65mm. Length of Female, 43mm. to 46mm.; expanse of wings, 64mm. to 66mm.

Male Imago.

Head bright metallic blue; labrum and rhinarium brown; labium black. *Eyes* distant, spherical, reddish. *Ocelli* conspicuous. *Prothorax* of fair size, blue. *Thorax* blue, with a greenish tinge in places, a few projections between the wings and at their insertion yellowish. *Legs* long, slender, black. *Wings* hyaline, with a large elliptical dark opaque patch, blue in some lights, extending from the costa to the hind-margin of the wings, and considerably nearer the apex than the base. *Pterostigma* absent. *Abdomen* long, slender, of about uniform thickness throughout, bright blue, generally with a greenish tinge towards the extremity. *Anal appendages* bluntly terminated; upper incurved at the tip and there flattened, black; lower shorter, straight, black above, pale below.

Female Imago.

Metallic green takes the place of the blue of the male, this colour being tinged with a coppery tint towards the extremity of the abdomen. The tenth segment has a

mid-dorsal yellowish raised line, terminating in a posterior point; this line is continued but not raised on the ninth, and sometimes part of the eighth, segment. *Wings* of a uniform pale yellowish-green, transparent, of about the same width as those of the male. *Pterostigma* white, near the tip of the wing. *Anal appendages* short, flattened, pointed, black. *Ovipositor* about as long as the ninth segment; *genital valves* reaching a little beyond it.

Distinction from C. virgo.

The males present no difficulty, but the females often bear a close resemblance to one another. In *C. splendens* the pterostigma is nearer the tip of the wings, which have a greenish tinge (brownish in *C. virgo* usually), and the reticulation is usually coarser than in the preceding species.

Immature Colouring.

In young specimens, the elliptical blue patch appears as a faint brownish cloud, which gradually deepens, and ultimately attains a blue reflection as maturity is reached.

Variation.

In the British Isles this species does not seem subject to much variation. Mr. McLachlan once exhibited at the Entomological Society of London a female taken in France, in which the left fore-wing was coloured as in the male, the corresponding right wing having also a few brown dashes.* De Selys ("Revue," p. 141) speaks

* E. M. M., 1865, p. 108.

of females having occurred in Prussia with wings coloured as in the male. He also describes northern and southern forms which occur on the Continent, and which he considers are due to difference of climate. In Britain the northern form is found.

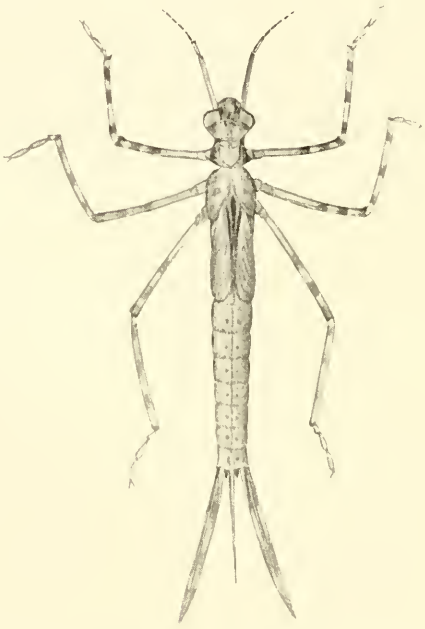


Fig. 37.—Nymph of Calopteryx splendens.
(× 2.)

Egg.

See *Calopteryx virgo* (page 218).

Nymph (Fig. 37).

Body warm brown, but not of a uniform tint (a female bred 1898 was very pale); long and slender; length,

including anal appendages, but not antennæ, about 32mm.; greatest breadth—at the meso-thorax—4mm. *Head* small, roughly pentagonal, with all the corners rounded; width about 4mm. *Antennæ* 6·5mm. long; seven-jointed, basal joint stout and longer than other six together; six distal joints, slender and gradually decreasing in size to the seventh, which is very small and pointed. *Mask* extending to the insertion of the mid-legs; very narrow at the joint, but suddenly expanding about half-way to the tip; the palpi and middle lobe closing up to form a spoon-shaped covering to the face, and projecting as a blunt point in the front of the head; middle lobe deeply divided into two long pieces, rounded at the end, and each bearing one bristle some distance behind the end; palpi long, terminating in three sharp points, and having about three bristles near the base of the long, sharp, movable hook. *Eyes* small, and not conspicuous, situated at the lateral corners of the head. *Ocelli* conspicuous, pale. *Occiput* of fair size, front- and hind-margins almost straight, and nearly parallel. *Prothorax* rather large, dark brown laterally, with a central, squarish pale patch. *Thorax* dark brown, with a central pale patch continuous with that on the prothorax. *Wing-cases* about 7mm. long, rounded at tip, costal margin rather pale. *Legs* long and slender, pale; femora and tibiæ each with three brown rings, some being more conspicuous than others; length of fore-legs about 13mm., of mid-legs 18mm., of hind-legs 19·5mm. *Abdomen* tapering gradually to the anal extremity, brown, lighter at the sutures, and along three lines—one mid-dorsal and two lateral—the dorsal one bearing a dark

streak on the basal part of each segment except the tenth; outside the lateral lines the ground-colour is a little darker; on each side of the mid-dorsal pale line on each segment is a small dark spot, and there are four similar ones on the dorsal part of each suture. Lateral *anal appendages* three-edged, 12mm. long; middle one flat, 8mm. long; all with about three dark bands. Judging from the small size of some specimens captured in the spring, this species must be more than a year reaching maturity. The nymphs should be sought for at the roots of reeds, and it would seem where the bottom is rather muddy. When resting on the weeds in confinement they are very difficult to see, and look like little pieces of decaying stems or broken sticks. They often rest flat on the mud, with their legs close to their sides, everything then being in longitudinal lines, even including the pale markings on head and thorax, and on the edges of the wing-cases. In this position they put one in mind of stick-like water-bugs. The appendages are often kept closed together, or nearly so. [Described from Surrey specimens.]

Date.

Towards the middle of May this species begins to appear on the wing in Surrey, the earliest date noticed being May 10. Thence it continues till quite the end of July, and a female was captured in Berkshire as late as August 19, in 1897. It is usually at its best in June.

Habits.

Whilst *C. virgo* appears to frequent the low bushes that overhang the streams, *C. splendens* seems to prefer

the rank herbage that grows along their margins. As these two conditions do not usually obtain in connection with the same stream, this is perhaps one reason why the two species are seldom found together.* Like its congener it is fond of running water, and does not frequent stagnant ponds. The flight of the two insects is similar also, being weak, and seldom sustained for many yards. These Dragonflies rest with wings closed over their backs amongst the low herbage near the banks of the stream they haunt.

Migration.

Though no migration of this species seems to have been recorded, it often wanders some distance from its haunts, and when so wandering its flight is by no means weak.

Distribution.

North of Yorkshire this species does not seem to have been recorded. Localities are: *Yorkshire:* Castle Howard (G. T. Porritt); Newton-on-Ouse (G. C. Dennis). *Cheshire:* Chester (J. Arkle); Ince Marshes (J. Arkle). *Wales:* North (J. Arkle). *Warwickshire:* Hockley Heath (A. D. Imms). *Worcestershire:* Near Worcester (J. E. Fletcher). *Shropshire:* Wyre Forest (R. C. Bradley). *Staffordshire:* Cannock Chase. *Herefordshire:* Near Symond's Yat (W. J. L.). *Oxfordshire:* Brighthampton (Mr. Stone's specimens in Oxford Museum); Yarnton (H. R. Smith's specimens in Oxford

* Entom., iii., p. 182; "Naturalist," April, 1897.

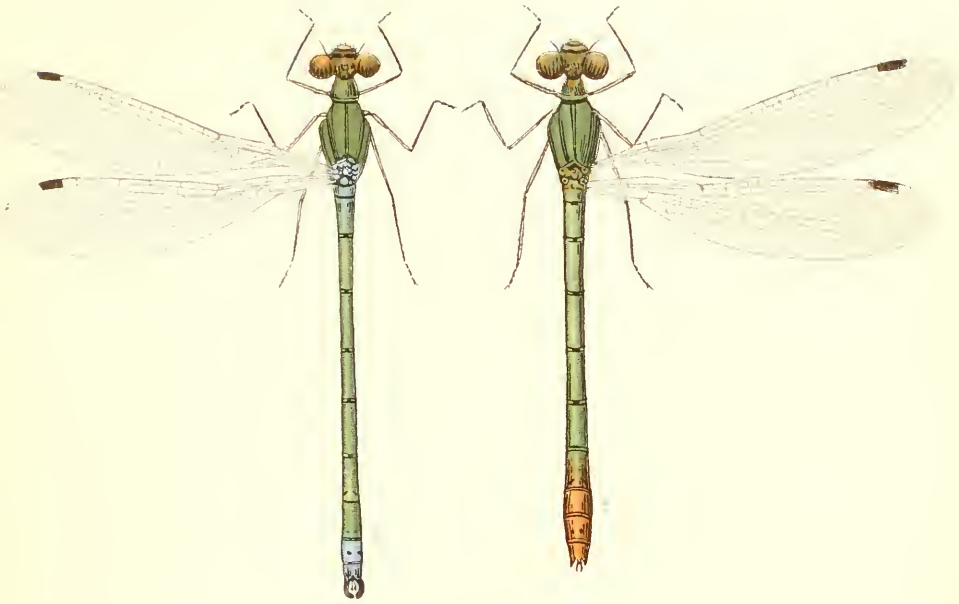
Museum). *Hampshire:* Shawford, near Winchester (W. J. Ashdown). *Berkshire:* Thames, at Windsor (F. A. Walker); near Eynsham (W. J. L.); Thames, near Nuneham (M. Burr); Maidenhead (G. T. Porritt); Reading (A. H. Hamm); Sulhampstead (E. B. Poulton). *Surrey:* Mole at Esher, near Byfleet, Wisley, Newark Abbey, Ockham Common (wanderers), near Weybridge, Esher Common (wanderers), and near Send (W. J. L.); White Falls, Leatherhead (C. A. Briggs); near Farnham (E. B. Bishop). *Middlesex:* Park (G. T. Porritt). *Essex:* Near Epping (H. Doubleday); Colchester (W. H. Harwood). *Cambridgeshire:* Littleport (C. A. Briggs). *Nottinghamshire:* Thorney Dyke (J. K. Morton). *Leinster:* Twy Laogh (J. J. F. X. King). *Munster:* Denough River (J. J. F. X. King); Skibbereen (J. J. Wolfe). *Connaught:* Carrowbeg River and Mackree Castle (J. J. F. X. King).

28. Lestes dryas, Kirby.

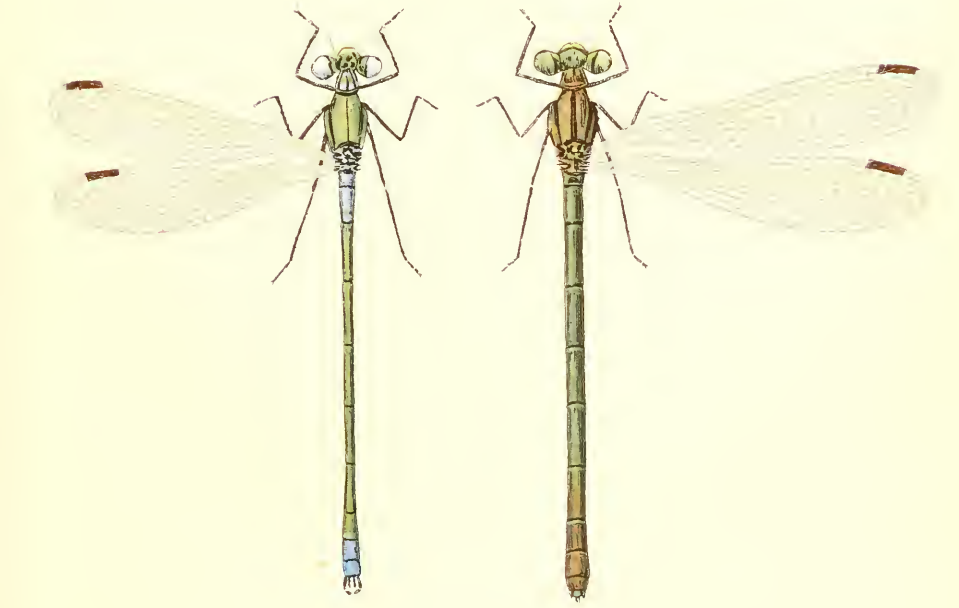
(Plate XXI.)

Synonymy.

Lestes dryas, Kirby Syn. Cat. Neur. Odon. 160 (1890). *Lestes nympha*, Selys Mon. Lib. Eur. 141 (1840); Selys Rev. Odon. 151 (1850); Hag. Ent. Ann. 57 (1857); McLach. Cat. Brit. Neur. 16 (1870). *Lestes forcipula* Ramb. Ins. Névr. 247 (1842).



Lestes dryas
(× 2)



Lestes sponsa
(× 2).

De Selys' description.

De Selys compares the insect with *L. sponsa*, but does not at the time consider it a distinct species. . . . "A part les différences de taille ; ils offrent les charactères suivants :—*Mâle adulte.* Il est à peu près saupoudré de poussière bleue comme celui de la *sponsa*, mais toutes les parties vert-bronzées sont fortement cuivrées au lieu d'être d'un vert pur. Le parastigma semble moins allongé ou du moins plus large que dans la *sponsa* et le diamètre des ailes peut-être plus grand en proportion. Tel est l'individu dont j'ai fait figurer les appendices anals ; mais je dois faire remarquer que la différence que les appendices inférieures présentent peut tenir à une monstruosité individuelle, puisqu' elle ne consiste qu'en plus de courbure l'un vers l'autre et en plus d'épaisseur ; ce qui peut se produire facilement lorsqu'il s'agit de corps mous comme ceux-ci. . . . *Femelle.* Semblable à celle de la *sponsa.* Le parastigma peut-être un peu moins allongé. L'abdomen plus épais ainsi que le diamètre de la tête. Les valvules de la lame cornée plus grandes, non dentelées. (E. De Selys-Longchamps, "Monographie des Libellulidées d'Europe," p. 141, 1840.)

[De Selys' name—*nympha*—cannot stand, for it had already been used by Stephens for an insect that there is little doubt was really a female *sponsa*, and De Selys therefore should not have applied it to another species. Rambur's name—*forcipula*—is not available for the same reason, Charpentier having, in 1825, bestowed it on *sponsa*.]

Size.

Length of Male, 36mm. ; expanse of wings 45mm. Length of Female, 35·5mm. ; expanse of wings, 48mm. [From two Cambridgeshire specimens.]

Male Imago.

Lower part of the *face* yellowish ; *labium* orange ; *head* chiefly bronze-green. *Eyes* blue. *Prothorax*, powdered with blue ; hind-margin straight. *Thorax* bronze-green above, powdered with blue below ; projections between wings and at their attachments blue. *Wings* large and broad. *Pterostigma* black, broad, long, extending over two or more cellules of the series below. *Legs* black, with a yellow line on the femora. *Abdomen* bronze-green, in some parts with a coppery tint ; but the first, ninth, and tenth segments are powdered with blue, while the second is partly so ; yellowish below, powdered with blue along the centre ; sutures yellow. *Anal appendages* black : their shape will be best understood from Fig. 38.



Fig. 38.—Anal Appendages of Lestes dryas (Male). Viewed from above.

(After Hagen, in De Selys' "Revue des Odonates.")

Female Imago.

This differs from the male in that it is shorter and much stouter ; on the *thorax* orange-yellow takes the place of blue. *Abdomen* is much tinged with a coppery sheen, especially on segments 8 to the end. There is no blue on the upper surface ; but the sutures and part of the first segment are yellowish-orange. *Wings* longer and broader than in the male. *Ovipositor* and *genital valves* very conspicuous, and extending slightly beyond the tenth segment. *Anal appendages* short, conical, pointed, black.

Distinction from Lestes sponsa.

L. dryas.	*L. sponsa.*
1. General appearance stouter.	1. Appearance more slender.
2. Wings longer and broader than in *L. sponsa*.	
3. Pterostigma long and broad.	3. Pterostigma long and rather narrow.
4. Bronze spot on first segment, divided in centre, and square at anterior corners. (Fig. 40).	4. Corners of spot decidedly rounded. (Fig. 40).
5. Anal appendages of female black.	5. Appendages to a great extent yellow.
6. Yellow ring at sutures generally interrupted dorsally.	6. Rings usually complete.
7. Anal appendages of male as in Fig. 38.	7. Anal appendages as in Fig. 39.

Immature Colouring.

In immature specimens the pterostigma is yellowish. The blue powder is at first absent from the males, and only appears gradually.

Nymph.

Brauer describes the nymph of *L. nympha* (= *dryas*) as follows: "Maske sehr lang, schmal, bis zwischen die Hinterbeine reichend; die fünf vorletzten Hinterleibs segmente zeigen einen kurzen, geraden seitenstachel; kiemen lang, breit" (Brauer and Löw, "Neuroptera Austriaca," p. xvi., 1857). Translation: "Mask very long, slender, reaching as far as between the hind-legs; the last five segments but one of the abdomen have a short, straight, lateral spine; lamellæ long and broad." [This description is generic rather than specific; it will apply equally well to *L. sponsa*.]

Date.

In Belgium, this Dragonfly is on the wing from the end of June to the beginning of August. In some parts of Europe it continues to the end of September (De Selys). In England, Mr. Morton has taken it in July and August; while Mr. King's immature Irish specimen was captured on June 27.

Distribution.

A few years since it was doubted whether *L. dryas* really existed in Britain, and to-day but few localities can be given for the species. Mr. Morton took it at Thorney, in Cambridgeshire, in 1893, and commonly in 1897; while he thinks it occurred in the same county at Knarr Fen Dykes in the former year. In 1891, Mr. C. A. Briggs took one female near Leigh, in Essex. If we add to this Mr. J. J. F. X. King's capture of a specimen on the Shannon towards Lough Ree, near Athlone, in 1894, the list of undoubted records is exhausted. In Doubleday's Epping List of 1871, however, we find it given as rare on Coopersale Common; but one cannot help thinking that there is some confusion amongst Doubleday's species of *Lestes*.

29. Lestes sponsa, Hansem.

(Plate XXI.)

Synonymy.

Agrion sponsa, Hansem. Wiedem. Zool. Mag. ii. (1) 159 (1823). *Lestes sponsa*, Selys Mon. Lib. Eur. 140 (1840); Selys Rev. Odon. 154 (1850); Hag. Ent. Ann. 57 (1857);

McLach. Cat. Brit. Neur. 16 (1870); Kirby Syn. Cat. Neur. Odon. 160 (1890). *Lestes nympha*, Steph. Illustr. Brit. Ent. Mand. vi. 77 (1836); (?) Evans Brit. Lib. 18 (1845). *Agrion forcipula*, Charp. Hor. Ent. 6 1825); Charp. Lib. Eur. 141, t. 34, f. 1, 2 (1840). *Lestes forcipula*, Steph. Illustr. Brit. Ent. Mand. vi., 78 (1836); Evans Brit. Lib. 18, pl. 6, f. 4 (1845). *Agrion picteti*, Fonsc. Ann. Soc. Ent. Fr. vii., 557, t. 13, f. 4 (1838). *Agrion spectrum*, Kol. Bull. Mosc. xxix. (4) 501 (1856).

Hansemann's description.

"A. alis patulis petiolatis hyalinis, stigmatibus oblongis nigris, capite immaculato, thorace supra viridi, maris immaculato, fœminæ subtrilineato." Then follows a long account of the insect in German. (J. W. A. Hansemann, "Wiedemann's Zoologisches Magazin," vol. ii., p. 159, 1823).

Size.

Length of Male, 37mm. to 39mm.; expanse of wings, 40mm. to 44mm. Length of Female, 35·5 to 39mm.; expanse of wings, 43mm. to 47mm.

Male Imago.

Face yellow; *top of head* between the eyes dark green, below bluish; *ocelli* conspicuous. *Eyes* blue. *Prothorax* powdered with blue; two large bronze-green spots on the dorsal surface. *Thorax* bronze-green above, powdered with blue below; between the wings also powdered with blue. *Legs* black, except under side of femora, which is yellowish. *Wings* hyaline, rather closely meshed. *Pterostigma* rather narrow, long, almost black.

Abdomen slender; segments 1, 2, 9, and 10 blue above and below; the rest bronze-green above; brownish below, dark along centre. *Anal appendages* black; upper somewhat flattened, turned in at tip, with two strong internal indentations; lower straight, flattened at tip, not dilated. The shape of the appendages will be best seen from Fig. 39.



FIG. 39.—ANAL APPENDAGES OF LESTES SPONSA (MALE).

(After Hagen, in De Selys' "Revue des Odonates.")

Female Imago.

The general bronze-green colour has a distinct coppery tinge, often very pronounced. *Eyes* greenish. *Prothorax* and underside of rest of *thorax* dull orange. Between the wings orange. *Legs* brown, with a black line. *Wings* with a faint yellowish-brown tinge. *Abdomen* brownish-yellow at the sides and below, with a dark line along the middle of the ventral surface; on the dorsal surface large bronze spots, which cover all but the sutures; first segment with a bronze-green twin spot rounded off at the anterior corners (Fig. 40); eleventh segment small, brownish-yellow. *Anal appendages* short, pointed, brownish. *Ovipositor* and *valves* dark, reaching to end of tenth segment and curved upwards at tip.



FIG. 40.—BRONZE SPOT ON SEGMENT 1 OF LESTES.

a, dryas. *b*. sponsa.

Immature Colouring.

Till the blue powder appears, the male resembles the female in colour; and at that time the twin green spot on segment 1 is visible, and assists in distinguishing this species from *L. dryas*. The pterostigma is yellowish.

Variation.

This species does not appear to be subject to much variation.

Oviposition.

Mr. P. Calvert states* that Von Siebold saw the female descend below the surface of the water, as seems to be customary with the genera *Agrion* and *Enallagma*; but in this case the male accompanied the female below the surface. The dirty appearance often presented by the abdomen of the female suggests oviposition in the mud.

Nymph.

Length, including caudal lamellæ, 26·5mm., *width* of abdomen, 2·25mm. *Head* a flattened pentagon; narrow from front to back; about 3·5mm. across transversely. *Eyes* large; apparently hemispherical when entire; situated at the fore lateral corners of the head. *Antennæ* seven-jointed; very long; basal two joints stout, next more slender, distal four *very* slender. *Mask* ladle-shaped; stem very fine, then suddenly swelling out near the end to a spoon shape; extending to the insertion of the hind-legs; long hairs in a line broken in two on body

* Transactions of Amer. Ent. Soc., xx. p. 189.

of mask; a row also near the outer margin of each palpus, all but one being on the movable hook, which is slender, sharp, and curved in at the point; middle lobe of mask produced in an obtuse angle, cleft in the centre and serrated along margin; palpi distinctly two-branched, the inner being serrated along inner margin and having an incurved hook at the tip; the outer branch with a sharp hook at the two corners and a small row of serrations between; the mask as a whole approaches somewhat that of genus *Calopteryx*. Occiput apparently rather narrow; a little concave behind; sides sloping backwards; hind corners rough with points. *Prothorax* somewhat quadrilateral in shape, broader behind; *Meso-thoracic spiracles* visible, dark. *Thorax* with a few scattered rough points. *Wing-cases* short, 5·5mm., barely reaching the fourth segment. *Legs* slender; fore-legs, 7·5mm. long, mid- 9·5mm., hind- 12mm.; lines of rough points along them; a somewhat distal dark ring on femora; distal ends of femora, tibiæ, and tarsal joints dark. *Abdomen*, fifth to ninth segments with small, straight, lateral spines; upper surface with numerous dark points, very much closer together in a raised ridge along middle of segments 9 and 10, which last has a ring of points on its hind-margin; a mid-dorsal pale line along the abdomen; sutures, except between 9 and 10, dark, and having a still darker spot on each side of the pale line, and another near the lateral margin. *Lamellæ* very long, nearly 10mm.; rounded at tip; broadest near the base, then more or less parallel; middle one a trifle broader, curved downwards at tip; in colour much resembling a thin lamina of tortoise-shell, the dark blotches being

arranged roughly in three bands; some specimens have paler lamellæ, these perhaps being females; margins provided all round with short spines; lamellæ seem rather thick and easily divided into two layers; there seem to be no proper tracheæ, except perhaps a medial one. Are the lamellæ used for breathing? [Described from empty nymph-cases obtained on Ockham Common, when the insect was emerging. The colour was pale russet-brown; what it was in the living nymph I cannot say.]

Date.

About the middle of July this species usually begins to appear, though De Selys gives June for the British Isles, and Mr. C. W. Dale records it for North Uist, in the Hebrides, in the same month. It is plentiful in August and September; while the author took it in Surrey as late as October 2, in 1898.

Habits.

Flying low amongst the herbage by the sides of ditches and ponds, this abundant little Dragonfly is not very conspicuous. Unlike the *Agrionidæ* generally, it rests with its wings half open.

Distribution.

Though this species is in all probability well distributed in the British Isles, records of its occurrence are by no means numerous. *Yorkshire:* Thorne, and Strensall Common (G. T. Porritt). *Cheshire:* Delamere Forest district (J. Arkle). *Cambridgeshire:* Everywhere common (K. J. Morton); Littleport (C. A. Briggs).

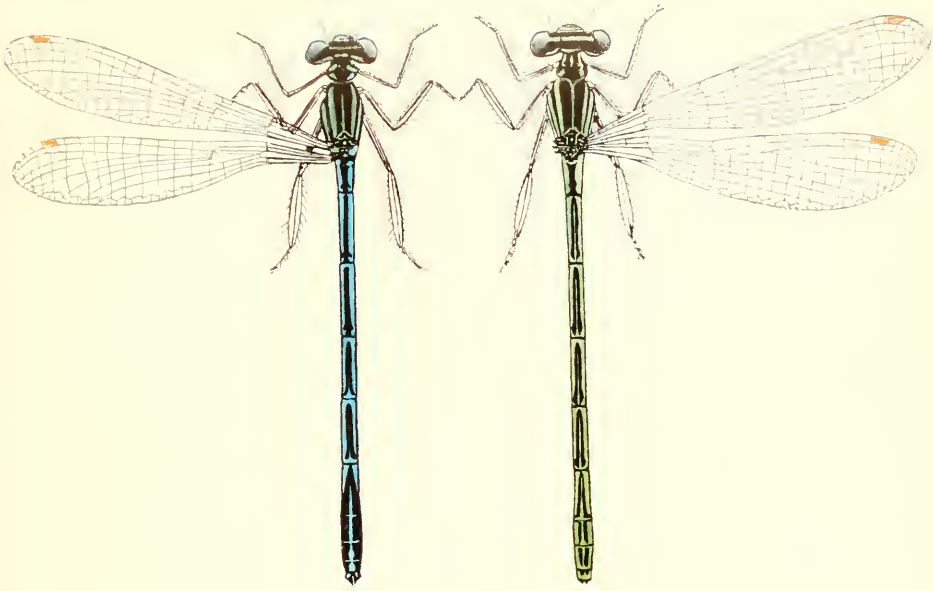
Suffolk: (Evans Brit. Lib., p. 18). *Essex:* Near Epping (H. Doubleday); Dudden Hill and Wanstead Park (F. A. Walker). *Kent:* Deal (C. G. Hall); Sandwich (W. J. L.). *Surrey:* Ockham Common, near Elstead, Esher Common, one (W. J. L.); Wendlesham (J. E. Tarbat). *Sussex:* Winchelsea Marshes (W. J. L.); Shoreham (H. J. Turner). *Hampshire:* New Forest (W. J. L.); near Lymington (S. A. Blinkarn); Bournemouth (R. C. Bradley). *Inverness-shire:* North Uist (C. W. Dale); Strathglass (J. J. F. X. King). *Argyllshire:* Near Dalmally, common, and Ledaig (J. J. F. X. King). *Ulster:* Near Glasslough, Co. Monaghan, common (K. J. Morton). *Munster:* Kilbrean Laogh (J. J. F. X. King).

30. Platycnemis pennipes, Pall.

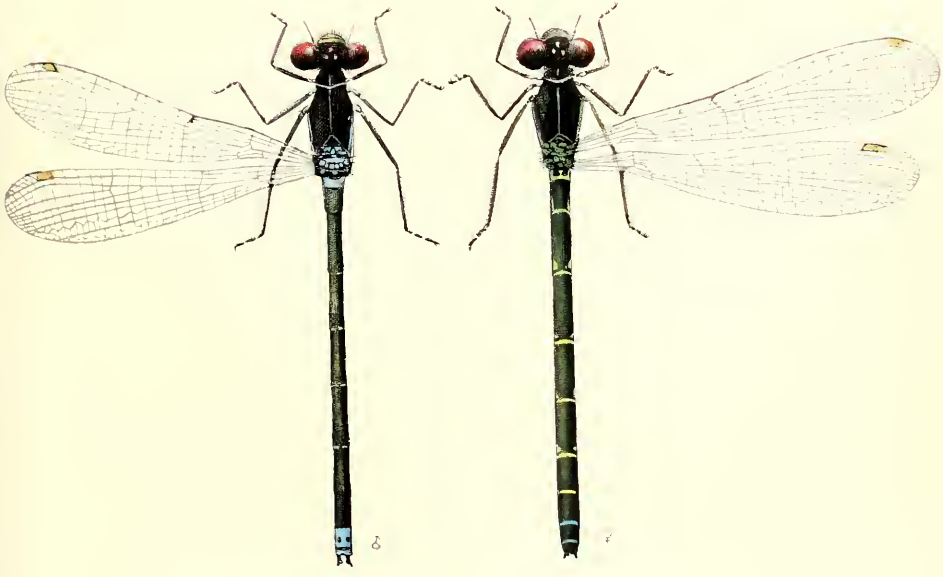
(Plate XXII.)

Synonymy.

Libella pennipes, Pall. Reisem. i. 469 (1771). *Platycnemis pennipes*, Selys Rev. Odon. 168 (1850); Hag. Ent. Ann. 56 (1857); McLach. Cat. Brit. Neur. 16 (1870); Kirby Syn. Cat. Neur. Odon. 129 (1890). *Agrion platypoda*, Lind. Opusc. Scient. iv. 102, n 4, t. 3, f. 4 (1823); Lind. Mon. Lib. Eur. 37 (1825); Steph. Illustr. Brit. Ent. Mand. vi. 76 (1836); Selys Mon. Lib. Eur. 148 (1840). *Platycnemis platypoda*, Evans Brit. Lib. 17, pl. vi., f. 1, 2 (1845). *Agrion lacteum*, Charp. Hor. Ent. 11 (1825); Charp. Lib. Eur. 165, t. 43, f. 2 (1840). *Puella nitidula*, Brullé Exped. Morée ii. (1) 105, t. 32, f. 8 (1832). *Agrion puella*, var. Fabr. Spec. Ins. i., 528, n. 2 (1781).



Platycnemis pennipes
(× 2).



Erythromma naias
(× 2).

Pallas' description.

Forma et *magnitudo* Libellæ Puellæ. *Thorax* fasciatus, ut in eadem. *Caput* fascia et striga transversa inter oculos; ceteroquin corpus albissimum, levissime rubicundo vel cœrulescente varians. *Abdomen* subtus linea longitudinali atra, quibusdam triplicata; accedente etiam dorsali, magis minusve interrupta. *Pedum* femora bilineata, utrinque ciliata; tibiæ dilatatæ, ciliisque subpennatæ, albæ, rhachi lineari nigra. *Alæ* hyalinæ, areola versus apicem fusco-lutescente. (P. S. Pallas, "Reisen durch verschiedene Provinzen des Rüssischen Reiches in den Jahren, 1768-74," vol. i., p. 469, 1771-76.)

Size.

Length of Male, 36mm. to 37mm.; expanse of wings 43mm. to 46mm. Length of Female, 36mm. to 38·5mm.; expanse of wings, 45mm. to 48mm.

Male Imago.

Head, face blue, but labrum and labium yellowish; top of frons and of head black, with a blue interrupted line across the latter in the region of the front ocellus; occiput greenish-blue. *Eyes* blue. *Prothorax* greenish below, black above with greenish lines. Rest of *thorax* pale green below; above black with two longitudinal green lines on each side; projections at the attachment of the wings and between them bluish-green. *Legs* whitish-blue, with a dark line along the upper surface; tibiæ much dilated and fringed with black hairs. *Wings* hyaline. *Pterostigma* small, brown. *Abdomen* pale blue, spotted with black, and with black sutures between the

segments; on segment 1 the spot is squarish, with projections at the anterior corners; on 2 to 5 a longitudinal rectangular spot, with a projection on each side near the distal end; often these spots almost or entirely disappear, the projections being the last to go, but that on 2 does not go so readily as the others; specimens are found at all intermediate stages. On 6 a mid-dorsal spot, increasing in width from the base; on 7 to 10 the black spot almost fills each segment; the dorsal carina is sometimes blue on most segments, and is generally so on 6, 7, and 8, and it swells into a spot on 9 and 10; there are also some small lateral black spots. *Anal appendages*, upper triangular, blue; lower cylindrical, blue at base, then produced into a sharp black incurved point.

Female Imago.

Stouter than male, which, however, it resembles in most respects. The blue gives place to yellow with a greenish tinge. *Pterostigma* yellow. Tenth segment of abdomen unspotted, and ninth nearly so. *Anal appendages* triangular, short, greenish-yellow. *Ovipositor* reddish, slender, sharp, curved upwards at tip, as long as the ninth segment. *Valves* a little longer, yellowish.

Variation.

In the description of the male the great variation in the dorsal spots has been referred to. When the carina is of the ground-colour, the spots appear as two parallel lines; it is this form apparently that De Selys names var. *bilineata*. This Dragonfly varies also in the ground-colour, which is sometimes white or whitish, the spots being reduced at the same time. This form has

received the varietal name *lactea*, as well as others indicative of its pale colour.

Oviposition.

On one occasion in the New Forest a pair was noticed, united *per collum*, resting on a yellow water-lily blossom. The female was moving the extremity of her abdomen along the surface of the stem, and no doubt inserting eggs in it, but they could not be found. If the female was ovipositing, the eggs would have been above the water till the seed-pod of the lily bent down to the surface.

Nymph.

General *colour* yellowish-brown, with darker brown markings. *Length*, including caudal lamellæ, about 20mm., *width* of abdomen about 2·15mm. *Head* pentagonal ; rather large ; about 3mm. transversely, a little less longitudinally ; a few darker markings on the top. *Eyes* rather large ; hemispherical, situated at the fore lateral corners of the head. *Antennæ* rather long and conspicuous ; seven-jointed, basal two stout, rest slender and darker, except near the sutures. *Mask* of the *Agrion*-shape, extending to the insertion of the fore-legs ; four long hairs on body of mask in a straight transverse line ; three near the margin of each palpus ; middle lobe produced in an obtuse angle, margin serrated ; palpi bifid, inner division with a sharp point and serrated inner margin, outer division with a few serrations at end ; movable hook rather small, slender, sharp. *Occiput* rather narrow ; slightly concave behind ; corners with rough points ; two dark spots in

middle; light dots on surface. *Prothorax* fairly large; produced laterally into a point; colour dark at sides and down centre, the mid-dorsal line, however, light. *Thorax* small, with brown markings, on which are some pale dots. *Legs*, length of fore-legs about 7.5mm., mid- 9·25mm., hind- 11mm.; with longitudinal lines of rough points; two darker rings on femora and tibiæ; darker also at or near distal end of joints, especially extreme joint of tarsus; with a few faint, scattered hairs. *Wing-cases* about 5mm., reaching about to the end of the fifth segment. *Abdomen*, posterior angles of segments projecting considerably, and 5 to 9 possessing a short spine; colour pale down centre and along lateral margins, darker between, the darker part bearing tiny pale spots; on each side of pale mid-line a basal dark line, reaching half-way along the segment, absent from 10; in middle of pale line a fine dark one, most conspicuous at base of segments; sutures with dark spots; hind-margin of 10 surrounded by a ring of points. *Caudal lamellæ* long, 7·5mm.; lanceolate, ending in a long slender point; with scattered hairs on margin, longer near the apex; middle lamella apparently a little the broader; all lightly spotted and with central trachea and lateral branches. [Described from a single nymph which disclosed a female on July 10, 1899. It was taken in the New Forest on June 4.]

Date.

June 4, is the earliest date on which I have noticed this species, and the latest August 19. It is common in the New Forest in the beginning of August.

Habits.

Judging from the localities in which I have myself taken this Dragonfly, it seems to like moving water rather than ponds or stagnant ditches. On the wing the blue males resemble *A. puella*, *A. pulchellum*, *A. mercuriale*, or *E. cyathigerum*, and they fly in a similar manner, but they may generally be seen to be a trifle larger than most specimens of the four species just mentioned, and, when approached more closely, a little lighter in tint. The females and whitish males may, of course, be easily distinguished, as they look quite pale upon the wing. Mr. C. A. Briggs has noticed that *P. pennipes* is sometimes found far from water.

Distribution.

But few localities have been recorded for this interesting species, and all of them in the middle or south of England. *Worcestershire:* Worcester, common (G. T. Porritt). *Warwickshire:* Near Earlswood (W. H. Bath, *Nat. Gazette*, p. 51, 1891). *Oxfordshire:* Brighthampton (Mr. Stone's specimens in Oxford Museum). *Devonshire:* (Evans Brit. Lib., p. 17). *Dorsetshire:* (W. H. Bath, "Handbook," p. 75). *Hampshire:* New Forest, common (W. J. L.). *Berkshire:* Near Eynsham (W. J. L.). *Surrey:* Esher Common, one, and Newark Abbey near Ripley, common (W. J. L.); Ockham Common, sparingly, Mickleham Downs, and near Cobham (C. A. Briggs). *Kent:* (Evans Brit. Lib., p. 17). *Middlesex:* River Lea at Park (G. T. Porritt). *Essex:* Epping (C. A. Briggs). *Norfolk:* (W. H. Bath, "Handbook," p. 75).

31. Erythromma naias, Hansem.

(Plate XXII.)

Synonymy.

Agrion naias, Hansem. Wiedem. Zool. Mag. ii. (1) 158 (1823); Selys Mon. Lib. Eur. 151 (1840); Selys Rev. Odon. 177 (1850); Hag. Ent. Ann. 58 (1857). *Erythromma naias*, Selys Bull. Acad. Belg. (2) xli. 1302 (1876); McLach. Cat. Brit. Neur. 16 (1870); Kirby Syn. Cat. Neur. Odon. 152 (1890); *Agrion analis*, Lind. Mon. Lib. Eur. 40, n. 10 (1825). *Agrion chloridion*, Charp. Hor. Ent. 14, t. i. f. 21 (1825); Charp. Lib. Eur. 148, t. 37, upper Fig. (1840); Steph. Illustr. Brit. Ent. Mand. vi. 75, n. 12 (1836).

Hansemann's description.

A. alis erectis petiolatis hyalinis, earum interstitio læte coeruleo, stigmatibus rhombeis fuscis, capite immaculato, thorace maris supra immaculato, foeminæ subbilineato. Then follows a lengthy account of the insect in German. (J. W. A. Hansemann, "Zoologisches Magazin," Herausgegeben von Dr. C. R. W. Wiedemann, p. 158, 1823).

Size.

Length of Male, 34·5 to 35·5mm.; expanse of wings, 43mm. to 44·5mm. Length of Female, 35mm. to 35·5mm.; expanse of wings, 46mm. to 47mm.

Male Imago.

Head. Face reddish-brown; nasus and frons black, the two separated by a reddish-brown line; top of head and occiput black. *Eyes* red. *Prothorax* black above,

reddish-brown below. *Thorax* black above, powdered with blue below; sides bluish, with two black stripes; projections at insertion of wings, and between them blue. *Legs* black; underside of femora and coxæ yellowish-brown. *Wings* hyaline. *Pterostigma* small, rhomboidal, brown. *Abdomen*, segments 1, 9, 10, and basal part of 2, powdered with blue, first with a small basal black spot; other segments dark steel-blue above, with a black transverse mark across the segment near the distal end; sutures yellow; brownish below. *Anal appendages*, upper prominent, black, somewhat triangular, flattened, divergent at the end; lower, rounded, brown, with a short black projection above.

Female Imago.

Head, *thorax*, *legs*, and *wings* as in male, except that the face is yellower and pterostigma lighter; there are two interrupted yellowish lines on the front of thorax, and there is a yellow spot on hind margin of prothorax, and another on the front margin. *Abdomen*, first segment yellow, with a squarish bronze-black dorsal spot containing a tiny yellow triangular one in centre; rest bronze-black above, with sutures yellow, except between segments 7, 8, 9, and 10 where they are blue; below yellow. *Anal appendages* short, conical, pointed, black. *Ovipositor* slender, russet, sharp-pointed, reaching about half-way between segments 9 and 10. *Valves* yellow.

Immature Colouring.

Markings yellow. *Pterostigma* very pale; a bronze-green tinge to the black of male as well as of female. *Eyes* at first greenish-brown.

Variation.

This species does not appear subject to much variation.

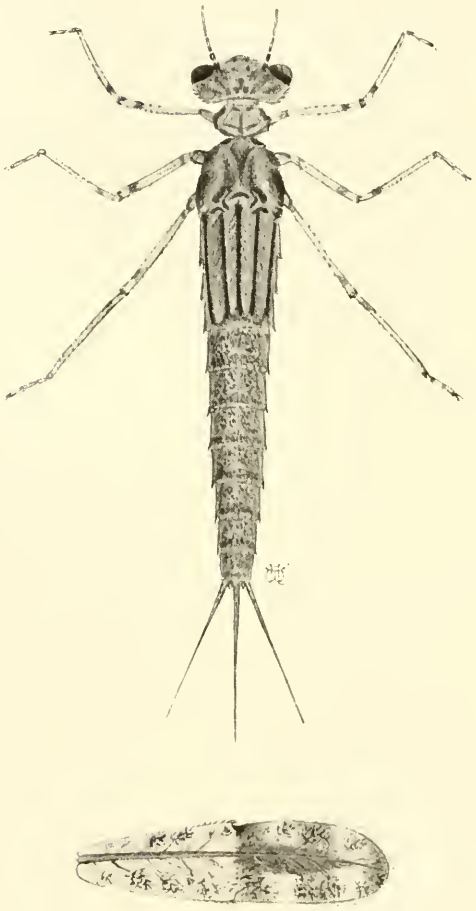


FIG. 41.—NYMPH OF ERYTHROMMA NAIAS (× 3); AND A CAUDAL LAMELLA MORE HIGHLY MAGNIFIED.

Nymph (Fig. 41).

Body long and slender; bright green, pale livid buff, brown, or almost black; length, including caudal lamellæ, 30mm., greatest breadth about 3·75mm. *Head* pentagonal, very narrow from front to back, 4·75mm. by 2mm. *Antennæ* (Fig. 42), seven-jointed, distal two being very intimately united and appearing to be one; basal two stout and dark; next long, slender, and dark, with a pale ring round centre; the rest pale and slender. *Mask* (Fig. 43), diamond-shaped, with the anterior corner rounded; extending to the insertion of the first pair of legs; the two palpi bearing a row of long hairs near the outer margin; their anterior margin jagged; the movable hooks sharp and slender, and overlapping when the mask is drawn back and at rest; a row of rather long hairs runs in a curve across the body of the mask, and on each side is a row of short ones near the outer margin. *Eyes* rather small, somewhat hemispherical, situated at the anterior corners of the head, dark in colour. Between the eyes are a few dark dots and markings. On the central part of the *occiput*, which is very narrow, are also some dark markings, while its posterior corners bear conspicuous spines. *Prothorax* somewhat rectangular



FIG. 42.—ANTENNA OF NYMPH OF ERYTHROMMA NAIAS.

(Much magnified.)

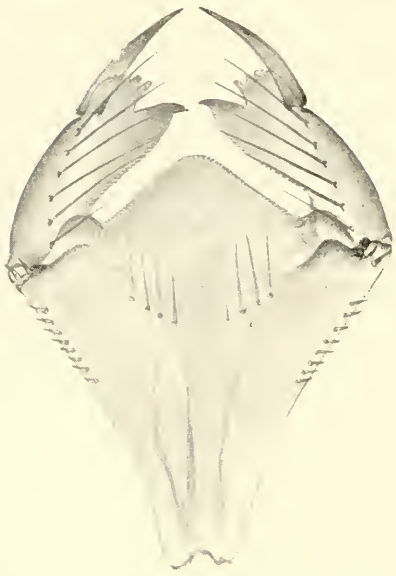


FIG. 43.—MASK OF ERYTHROMMA NAIAS.
(Much magnified.)

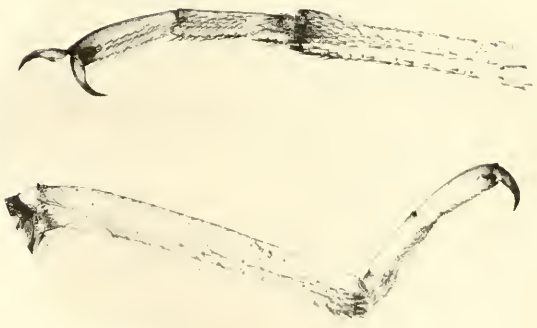


FIG. 44.—LEGS OF NYMPH OF ERYTHROMMA NAIAS.
(× 15 diameters.)

with the fore-corners removed, of moderate size, bearing one or two dark lines. *Wing-cases* short, 5·5mm. *Legs* (Fig. 44) rather long, fore- 8·5mm., mid- 10mm., hind- 13mm., paler than the general ground-colour; on each femur two conspicuous dark rings, and one near the basal end of the tibiæ; all the legs have several



Fig. 45.—Part of a Caudal Lamella of Nymph of Erythromma naias.

(Much magnified.)

longitudinal rows of small dark points. The *abdomen* tapers gradually to the posterior extremity, and is irrorated with small black dots; the segments are fairly equal, and each, except the tenth, is bounded posteriorly by a row of about eight white dots, very conspicuous on dark specimens. Each segment, except the tenth, has a

tiny lateral posterior spine; a medio-dorsal paler line may just be distinguished, and on each side of it, rather nearer the hinder edge of each segment, is a small pale mark; there is also a pale lateral line. The *caudal lamellæ* (Fig. 45) are 8mm. long, and of much the same width throughout (about 2mm.); the tip is rounded, and each lamella is divided into two parts; the basal



Fig. 46.—Largest Spine on Margin of Caudal Lamella of Nymph of Erythromma najas.

(Very highly magnified.)

half has the margin spiny (Fig. 46), especially on the upper edge of the central one and the lower edge of the other two (for the outer ones are reversed in position); the decided nick on the more toothed margin is very noticeable. The apical half of the lamella has a fringe of extremely fine hairs, and bears three transverse brown bands and a longitudinal one along the median trachea,

which is stout ; the branch tracheæ have their smaller branches conspicuously dark in colour and arborescent in structure. The end of the tenth segment is surrounded with small points, and between the dorsal and each of the lateral lamellæ is a small conical projection. These nymphs are extremely lively, swimming by a sinuous lateral motion of the body. When thus progressing, the lamellæ are closed, and the legs brought close to the side and stretched out at full length backwards ; when walking, however, the legs are arched and the thorax is raised. On being first taken from the water, or if disturbed, they often feign death for a time. [From Surrey specimens, bred on several occasions.]

Date.

In Surrey the earliest date recorded for the imago is May 6 (C. A. Briggs), and I have found it myself on July 16, when it did not appear to have reached the end of its season. It occurs in France as late as September. (De Selys.)

Habits.

On the wing the appearance of the male reminds one of *I. elegans*, and it might easily be passed over for that species. It is, however, more robust, perhaps flies more rapidly, and seems to be rather easily frightened. The female, which is comparatively seldom seen, might be confused with many of the darker *Agrionidæ*. The males often settle on floating weeds, such as *Potamogeton*. When immature, *E. naias* should be looked for on the bushes and herbage in the neighbourhood of its early home.

Distribution.

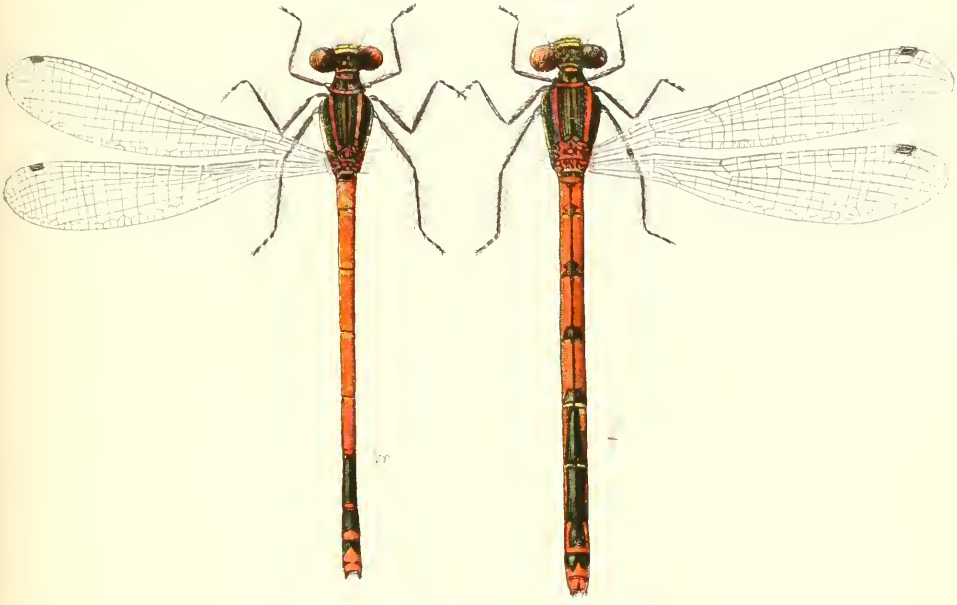
Apparently this insect is very local in the southern half of England. Very few localities have been recorded, but in more than one of these it is described as common. *Warwickshire:* Sutton Coldfield, common (R. C. Bradley). *Staffordshire:* Cannock Chase (R. C. Bradley). *Lincolnshire:* (Stephens). *Cambridgeshire:* Thorney River (K. J. Morton). *Essex:* Near Epping, common (H. Doubleday, 1871); Wanstead Park (F. A. Walker). *Middlesex:* River Brent (W. J. Ashdown). *Surrey:* Ockham Common; near Byfleet, common; Esher Common, one; Richmond Park, one (W. J. L.); Virginia Water (E. Vincent). *Dorsetshire:* (W. H. Bath, "Handbook," p. 81). *Ireland:* Belfast (R. McLachlan, E. M. M., 1884, p. 255).

32. Pyrrhosoma nymphula.

(Plate XXIII.)

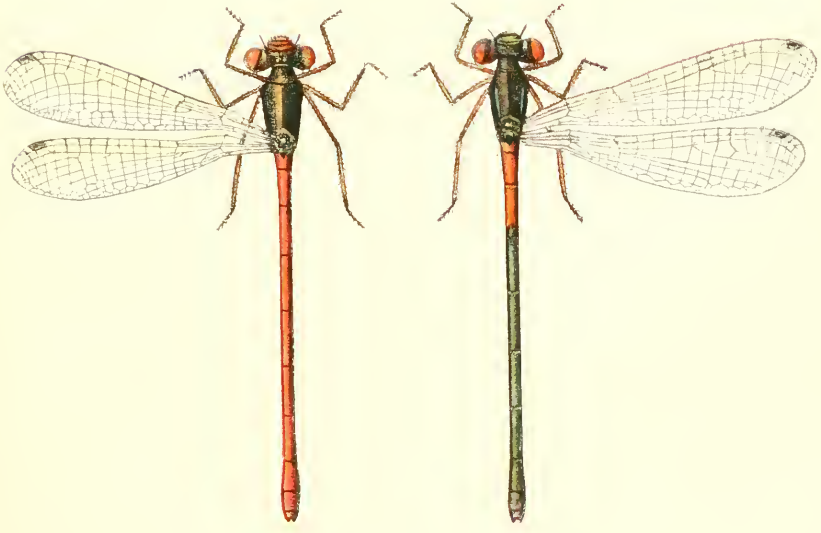
Synonymy.

Libellula nymphula, Sulz. Gesch. Ins. t. 24, f. 5 (1776); *Pyrrhosoma nymphula*, Kirby Syn. Cat. Neur. Odon. 151 (1890). *Libellula minius*, Harr. Expos. Eng. Ins. 97, t. 29, f. 1, 2 (1782). *Agrion minium*, Charp. Hor. Ent. 13 (1825); Charp. Lib. Eur. 146, t. 36, f. 2 (1840); Steph. Illustr. Brit. Ent. Mand. vi. 75, n. 10 (1836); Selys Rev. Odon. 178 (1850); Hag. Ent. Ann. 58 (1857). *Pyrrhosoma minium*, Evans Brit. Lib. 16, pl. 5, f. 3, 4 (1845); McLach. Cat. Brit. Neur. 17 (1870); Selys Bull. Acad. Belg. (2) xli.



Pyrrhosoma nymphula

(× 2).



Pyrrhosoma tenellum

(× 2).

1296 (1876). *Agrion amazon*, Hansem. Wiedem. Zool. Mag. (2) i. 152 (1823). *Agrion sanguinea*, Lind. Mon. Lib. Eur. 41 (1825); Selys Mon. Lib. Eur. 152 (1840). *Agrion sanguineum*, Ramb. Hist. Nat. Ins. Névr. 262 (1842). *Agrion fulvipes*, Steph. Illustr. Brit. Ent. Mand. vi. 75, n. 11 (1836). *Erythromma fulvipes*, Evans Brit. Lib. 16, pl. 5, f. 5 (1845). *Erythromma chloridion*, Evans Brit. Lib. 16, pl. 5, f. 6 (1845).

[Sulzer's description and figure seem to have been long overlooked, but they have six years' priority over those of Harris, and the alteration from *minium* to *nymphula* is therefore a necessity. In Evans, *E. fulvipes* seems to be a somewhat immature female of *P. nymphula*, and *E. chloridion* a very immature female of the same species. The apex of the abdomen with male appendages, by the side of *E. chloridion*, apparently belongs to *Erythromma naias*.]

Sulzer's description.

Lib. nymphula. Mit glaslautern Flügeln; der ganze Leib ist schön roth, der Brustschild grün und schwarz gestrichelt; der Hinterleib ist mit schwarzen Ringen. (J. H. Sulzer, "Abgekürzte Geschichte der Insekten, nach dem Linnéischen System," t. 24, f. 5, 1776.)

Size.

Length of Male, 35mm. to 37mm.; expanse of wings, 43mm. to 46mm. Length of Female, 33mm. to 37·5mm.; expanse of wings, 46mm. to 50·5mm.

Male Imago.

Face yellow, with black hairs; sutures between parts above mouth black. *Top of head* black. *Eyes* crimson. *Prothorax* black, margined with crimson. *Thorax* bronze-black on dorsal surface, with two longitudinal crimson stripes; yellow below; projections between wings crimson

Legs black ; coxæ yellow. *Wings* hyaline. *Pterostigma* small, rhomboidal, with upper distal corner more acute, brown, black in centre. *Abdomen* crimson, with black sutures, those between the basal segments being preceded by two yellow dots, and succeeded by a yellow line ; segment 1 with a large transverse bronze-black spot ; 7, 8, and 9 with a large basal spot, that on 7 occupying the greater part of the segment ; 10, with two small basal spots ; ventral surface yellow, with black middle line. *Anal appendages*, upper divided into two rather slender projections, blackish, with the points of the higher division incurved ; lower reddish, conical, with an internal swelling and final incurved hook, much stouter at the base than the upper ones.

Female Imago.

Generally much more bulky than the male, but closely resembling it. There is a little difference in the *prothorax*, but the sexes differ most in the *abdomen*. Segment 1 has the transverse black-bronze spot ; 2, 3, 4, 5 have a mid-dorsal black carina swelling out distally into a crown-shaped spot ; in 6, 7, 8 the spot nearly fills the segment ; 9 has a bifid basal spot, and 10 has two small basal ones. *Anal appendages* small, conical, crimson, with black tip. *Ovipositor* slender, red-brown, reaching quite to the end of the tenth segment. *Valves* yellow, as long as the ovipositor.

Immature Colouring.

On the head and thorax the crimson is for some days replaced by yellow ; on the abdomen it is at first dingy, but not yellow. *Eyes* greenish-brown. *Wings*

suffused with a yellow tinge. *Pterostigma* yellow. The dark markings are green-bronze rather than black-bronze.

Variation.

This species appears as a rule to vary very little. I have, however, a female from which the median carina of segments 2, 3, 4, 5 is absent, the swellings at its base being represented by tiny marks; the spot on segment 6 is reduced to a line with a distal swelling. De Selys ("Revue," p. 179) describes a female from Madrid in some respects the opposite of this. There is a broad bronze band along all the segments, enlarged towards the extremity of each; the yellow incisions are well marked, and the usual crimson marking on head and thorax are replaced by yellow. He adds that Mr. Dale sent him from Dorset a similar variety.

Oviposition.

In July, 1898, on Esher Common, two or three pairs were noticed flying, connected *per collum*, along a narrow ditch draining into the large pond. Presently one of these pairs went down to the water, and the female rested on a floating leaf of *Potamogeton*, whilst the male still held her, and remained with its body vertical and wings horizontal (Fig. 2, p. 13). The female then moved the anal extremity of her abdomen about over the leaf, as if she was ovipositing. After two or three minutes they flew away. The eggs could not at first be found; but when the leaf had withered, some little ridges were noticed, and these contained bodies similar to the eggs that had been extracted from the body of a female. The eggs were laid within the substance of

the leaf—a method of ovipositing which the ovipositor of the *Agrionidæ* seems well calculated to enable the insect to perform. In 1868, Mr. R. McLachlan found it ovipositing in the mud of a nearly dry ditch in the New Forest.

Egg.

Somewhat cylindrical, but thicker near one extremity, which tapers to a point, the other extremity being rounded. The contents have a granular appearance, and the egg is colourless and semi-transparent, in length about 1mm., and in greatest breadth about ·25mm. It resembles Nos. 6 and 7 of Fig. 4, p. 16.

Nymph (Fig. 47).

In *shape* long and slender, though less so than some others of the *Agrionidæ;* length, including the caudal lamellæ, 19mm.; greatest breadth about 2·5mm. General ground-colour dark sepia-brown. *Head* pentagonal; transverse measurement, about 3·25mm., longitudinal 1·75mm.; the lateral edges slope considerably backwards. *Antennæ* seven-jointed, basal two stout, the second darker distally; all remaining joints darker in centre. *Mask* flattish, triangular, narrow at the hinge, and produced anteriorly in an obtuse angle; extending to the insertion of the fore-legs; the palpi bearing a row of hairs near the outer margin; the sharp, slender, movable hooks interlacing when the mask is at rest; a half-circle of hairs on the body of the mask. *Eyes* rather large, situated at the fore-corners of the head; pear-shaped, with the stalk pointing backwards; colour dark brown. *Occiput* narrow, separated from eyes by a waved

line; hind-margin a little concave; bearing centrally a palish rectangle, with dark boundary, and crossed by two small parallel lines; posterior corners with

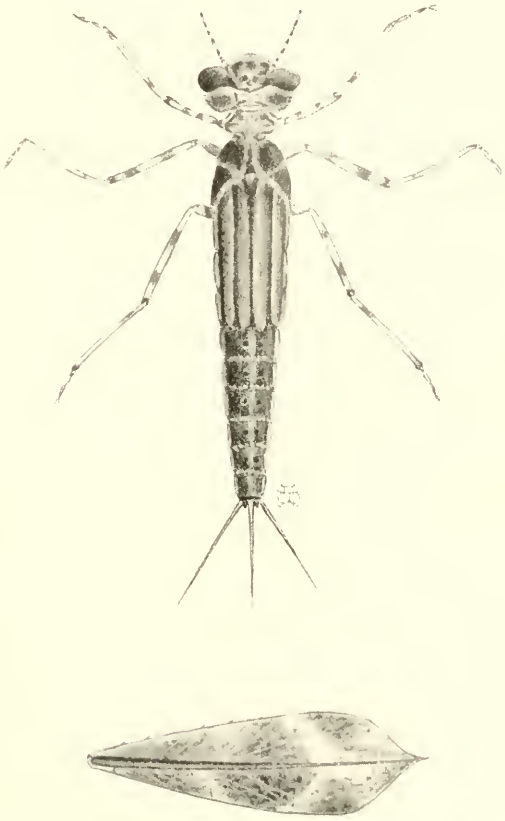


FIG. 47.—NYMPH OF PYRRHOSOMA NYMPHULA.
(× 4.)

conspicuous spines. *Prothorax* rather small, rectangular, with the four corners rounded, bearing some whitish

markings, notably a mid-dorsal longitudinal streak. *Wing-cases* long and straight, about 5mm. in length. *Legs* rather long; fore- about 7mm., mid- 8mm., hind- 11mm.; paler than the general ground-colour; on the femora two dark rings, on the tibiæ one rather faint one. *Abdomen* tapering posteriorly, the segments being fairly equal in length; each, except the tenth, bearing along its posterior margin a row of small white dots; a whitish lateral line along each segment, especially in older specimens; a mid-dorsal pale line, having on each side of it a black dot in each segment except the tenth; distal margin of tenth segment surrounded with small points; between the dorsal and each of the lateral lamellæ a small conical projection. *Caudal lamellæ* 5·5mm. in length; a sharp point at the extremity, and a strong median rib; in colour pale, much blotched with brown, and spotted with still darker brown. [Bred on several occasions from Surrey nymphs.] This nymph is fond of hiding under or between dead sunken leaves, where its colour protects it remarkably well.

Emergence of Imago.

On page 112 will be found a description of the emergence of an Anisopterid Dragonfly; that which follows gives the method of disclosure of *P. nymphula*, which appears to be sufficiently typical of the Zygopterids. On April 27, 1898, about 1 p.m., a nymph was noticed attempting to crawl up the edge of a dish, in which it had been placed some time before. When removed to another vessel and put in such a position that it could easily crawl up a stick, it did so in a very few minutes. By about 1.30 the imago had commenced to emerge. By

1.35 the legs were out, and the insect was still, except for occasional twitchings of the legs. Now occurred the usual *rest*, in this instance of about twelve minutes only, all parts being out except the last two or three segments of the abdomen. The head and thorax were not thrown back, as in the case of *Libellula quadrimaculata*, and judging from several emergences observed since, this is not done in the case of *P. nymphula*, but head and thorax are kept erect. Whether this is so with all Zygopterids remains to be proved. At 1.47 the insect began to wake up, bent forward, and used its legs to find a hold. At 1.52 it began to pull out the rest of the abdomen, which by 1.55 was quite free. The wings began then slowly, and quite imperceptibly, to expand from the base forward, the tips remaining opaque and crumpled till last. At 2.5 the wings were as long as the body. Continuing to grow, at 2.17 they exceeded the length of the body by about $\frac{1}{5}$in., and appeared to be of full size. They were then yellowish, and somewhat opaque. So far, the body had increased but little in length since emergence. The abdomen kept swaying from front to back, sometimes striking back sharply against the wings. The swayings and jerkings grew less till they practically ceased at 2.30, when the abdomen had increased decidedly in length, but was not so long as the wings. At 2.50 the body was about $\frac{1}{5}$in. longer than the wings, and was pale yellowish-brown in colour, but the crimson colouring had begun to appear dorsally, especially on the basal segments. The wings were fairly transparent, the pterostigma being yellow. The yellow lines on the thorax were bright; the legs were palish. When left at 2.50 the Dragonfly was

practically complete, except for its colouring. The specimen was a female. During the whole time the imago had not moved forward up the stick, but at the end of the metamorphosis was hanging immediately above the head of the nymph-case. In another instance, the rest lasted for twenty minutes, but the process of emergence was very similar, and the time occupied much the same.

Date.

In early seasons *P. nymphula* appears in April, the earliest date noted being April 29, when, in 1894, large numbers were out on Esher Common, in Surrey; but in average seasons it begins to emerge in early May. It is at its best in June, but may be taken through July, and even lingers till the beginning of August.

Habits.

This Dragonfly seems to like to make its haunt near ditches, streams, canals, &c., where vegetation is luxuriant. Here amongst the herbage and about the bushes it is often abundant.

Distribution.

There is no doubt that this species is well distributed and common throughout the British Isles, but, probably on account of this very fact, the recorded localities are by no means numerous. *Inverness-shire:* Strathglass (J. J. F. X. King); common at Loch-an-Eilan, Bobbin Mill at Kinrara, and along the banks of the Spey (J. J. F. X. King). *Argyllshire:* Near Dalmally, common, Isle of Mull, Ledaig, and Isle of Coll (J. J. F. X.

King). *Perthshire:* Breadalbane District (K. J. Morton); Rannoch, abundant (C. A. Briggs). *Lanarkshire:* Carluke District (K. J. Morton). *Westmoreland:* Langdale (J. J. F. X. King). *Yorkshire:* Thorne, Bishop's Wood near Selby, Wharncliffe Craggs, and Doncaster (G. T. Porritt). *Cheshire:* Delamere Forest and Heaths (J. Arkle). *Merionethshire:* Tan-y-bwlch, abundant, and Barmouth (A. D. Imms). *Worcestershire:* Near Worcester (J. E. Fletcher). *Warwickshire:* Sutton Coldfield (R. C. Bradley); Birmingham district, abundant (A. D. Imms). *Oxfordshire:* Cowley Marsh (A. H. Hamm). *Dorset:* Glanvilles Wootton (C. W. Dale). *Devonshire:* Near Plymouth (G. C. Bignall). *Berkshire:* Near Wokingham (A. H. Hamm). *Hampshire:* New Forest (W. J. L.). *Sussex:* Near Liphook (H. J. Turner); East, common (G. T. Porritt); Shoreham (H. J. Turner); Hailsham (G. T. Porritt). *Surrey:* Near River Mole at Esher, Esher Common, near Byfleet, near Chobham Common, near Send, River Wey at Wisley, near Longcross (W. J. L.); Ockham Common, one (C. A. Briggs); Ripley (W. J. Ashdown); near Weybridge (J. E. Tarbat). *Middlesex:* River Lea at Park (G. T. Porritt). *Essex:* Near Epping, abundant (H. Doubleday, 1871); Colchester (W. H. Harwood); Dudden Hill and Wanstead Park (F. A. Walker). *Kent:* Deal and Dover District, common (C. G. Hall); Folkestone (H. J. Turner). *Ulster:* Armagh (J. J. F. X. King). *Leinster:* Killucan and Twy Laogh (J. J. F. X. King). *Munster:* Denough River (J. J. F. X. King). *Connaught:* Carrowbeg River (J. J. F. X. King). *Guernsey:* Grande Mare, common (W. A. Luff).

33. Pyrrhosoma tenellum.

(Plate XXIII.)

Synonymy.

Libellula tenella, Vill. Linn. Ent. iii. 15, n. 27 (1789). *Agrion tenellum*, Selys Rev. Odon. 180 (1850); Hag. Ent. Ann. 58 (1857). *Pyrrhosoma tenellum*, McLach. Cat. Brit. Neur. 17 (1870); Kirby Syn. Cat. Neur. Odon. 151 (1890). *Agrion rubella*, Lind. Opusc. Scient. iv. 105, n. 7, t. 4, f. 6, 7 (1823); Lind. Mon. Lib. Eur. 42, n. 12 (1825); Selys Mon. Lib. Eur. 154 (1840). *Agrion rubellum*, Steph. Illustr. Brit. Ent. Mand. vi. 71, n. 1, pl. 29, f. 4 (1836); Evans Brit. Lib. 13, pl. 3, f. 1 (1845).

De Villers' description.

L. (la Thérese) alis hyalinis, puncto marginali minimo. Abdomine rubro, rubellove, thorace viridi lineato vel non lineato. (C. J. de Villers, "Caroli Linnæi Entomologia, Faunæ Suecicæ Descriptionibus Aucta," iii., p. 15, n. 27, 1789.)

Size.

Length of Male, 30mm. to 32mm.; expanse of wings, 33mm. to 36mm. Length of Female, 31mm. to 33·5mm.; expanse of wings, 36mm. to 39mm.

Male Imago.

Face crimson, with black line at base of nasus. *Top of head* black. *Eyes* crimson. *Prothorax* triangular, bronze, hind-margin straight, slightly raised. *Thorax* bronze above, livid below, projections between wings

reddish. *Legs* dull red. *Wings* hyaline. *Pterostigma* reddish. *Abdomen* slender, crimson, unspotted. *Anal appendages*, upper small, rounded, black; lower short, conical, pointing upwards, red, with black tip.

Female Imago.

Face yellow, base of labium and of nasus black. Dorsal surface of *thorax* usually with two very fine yellow, longitudinal lines. *Abdomen*, segment 1 crimson, with bronze spot; 2, crimson; 3, crimson, with a posterior bronze spot; the rest bronze, but 8, 9, and 10 have some crimson colouring on the dorsal surface; sutures yellowish; ventral surface brownish. *Anal appendages* very small, conical, reddish. *Ovipositor* reaching to end of tenth segment, red. *Valves* rather broad, dull yellow, as long as ovipositor.

Immature Colouring.

Pterostigma pale. In the female the crimson, especially at the distal extremity of the abdomen, is replaced by a reddish orange tint; but in both sexes the abdomen early assumes its crimson colour.

Variation.

Varietal forms seem to be confined to the female. De Selys describes a specimen of this sex, which closely resembled a male: the abdomen had no spots, but the extremity of the segments was very finely circled with bronze; the face also resembled that of a male. He mentions another very like the last, but having a touch of bronze at the extremity of segments 6, 7, and 8, the face being as in the type. In 1898, I took in the New

Forest one or two females in which variation had taken place along exactly opposite lines. In these the abdomen was either entirely bronze or very nearly so. Their identity was at first not easily made out. De Selys mentions ("Revue," p. 181) that Mr. Dale took varieties of a similar kind to the last in Dorsetshire.

Egg.

Somewhat spindle-shaped; one extremity rounded, the other tapering to a point. Towards the pointed end the breadth is a little greater than elsewhere. Length about ·8mm., greatest breadth about ·2mm. Almost colourless, but with just a faint yellowish tinge. Contents granular. [Extracted from a female captured on Esher Common, on September 11.] (Fig. 4, No. 7.)

Date.

This is one of the summer Dragonflies, appearing on the wing just before the middle of June. Thence it continues to fly for about three months. The earliest date on which I have seen it is June 9, and the latest September 21.

Habits.

Slender, delicate form and feeble flight seem to be the most prominent characters of *Pyrrhosoma tenellum*. It often rests on the rushes and taller grasses round the margin of the ponds, and so on, that constitute its haunt. As it is usually plentiful where it occurs, it sometimes rises in large numbers when its habitat is invaded.

Distribution.

Being of South European distribution, *P. tenellum* is a Dragonfly that we should not have expected to find in England. Not only is it distinctly British, however, but in some of its haunts it is very plentiful. Moreover, it certainly extends as far north as Cambridge, and perhaps even farther still. In *Surrey* it has been taken at Weybridge (R. McLachlan, 1874); it is abundant on Esher Common (W. J. L.), and has been reported from Merton (J. S. Brocklesby). In *Hampshire* it occurs in many parts of the New Forest (W. J. L.), and at Bournemouth (R. C. Bradley). In *Sussex* a female was on one occasion taken near Liphook (W. J. L.). H. Doubleday, in 1871, said it was formerly very common near Epping, in *Essex;* and De Selys ("Revue," 1850) gives *Dorset* (Dale) as a locality. In *Cambridgeshire* it occurs at Chippenham Fen, commonly, and at Wicken Fen (G. T. Porritt); while Mr. J. Arkle reports that at Abersoch, in *Lancashire*, he once came across large numbers of what he took to be small specimens of *P. nymphula*. On seeing a series of *P. tenellum*, he felt that he had made a mistake, and that the insects belonged to the latter species. He, however, had no specimens to confirm his supposition, so this northern locality is at present only conjectural. His description of the habits of the insects, however, seems to point to the more interesting species.

34. Ischnura pumilio.

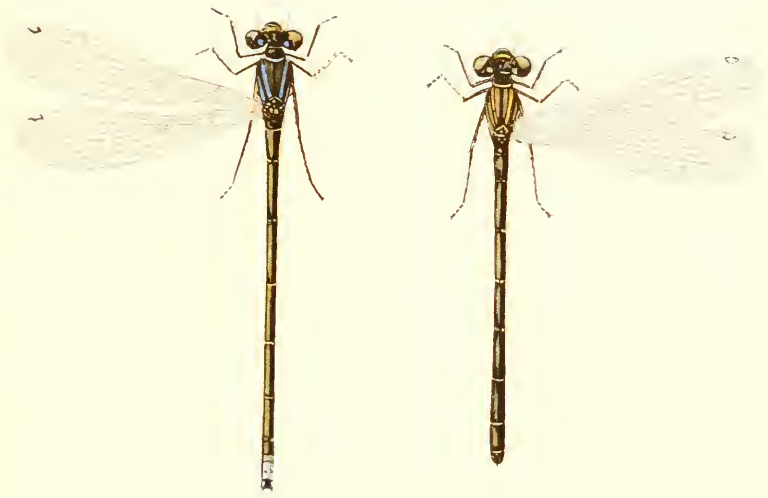
(Plate XXIV.)

Synonymy.

Agrion pumilio, Charp. Hor. Ent. 22 (1825); Charp. Lib. Eur. 154, t. 39 (1840); Selys Mon. Lib. Eur. 156 (1840); Selys Bull. Acad. Belg. vii. (2) 94 (1840); Selys Rev. Odon. 182 (1850); Hag. Ent. Ann. 59 (1857). *Ischnura pumilio*, Evans Brit. Lib. 17, pl. 5, f. 7 (1845); McLach. Cat. Brit. Neur. 17 (1870); Selys Bull. Acad. Belg. (2) xli. 267 (1876). *Micronympha pumilio*, Kirby Syn. Cat. Neur. Odon. 140 (1890). *Agrion elegans*, Fonsc. Ann. Soc. Ent. France vii. 565, t. 14, f. 7, a, b (1838). *Agrion cognata*, Selys Rev. Zool. 214 (1840). *Agrion rubellum*, var. Curt. Brit. Ent. xvi., pl. 732 (1839). *Agrion xanthopterum*, var. Steph. Illustr. Brit. Ent. Mand. v. 72 (1836); Evans Brit. Lib. 13, pl. 3, f. 2 (1845). *Agrion aurantiaca*, var. Selys Cat. Lep., &c., Belg. 12 (1837); Selys Mon. Lib. Eur. 159 (1840); Fonsc. Ann. Soc. Ent. France vii., 570, t. 15, f. 3 (1838).

Charpentier's description.

Agr. aeneum, flavido et coeruleo pictum: collaris margine postico leviter rotundato. . . . Minimum omnium Agriorum europaeorum, mihi huc usque notorum. Agrio tuberculato (= *Ischnura elegans*) affine, structura collaris, magnitudine multo minore, ultimi segmenti appendicumque maris diversa structura satis distinctum. Caput ut in A. tuberculato constructum, sed paullo majus quam in illo, si totius animalis magnitudinem respicias. Collare transversum, antice angustum, nigro-aeneum, undique



Ischnura pumilio

(× 2).



Ischnura elegans

(× 2).

colore ex flavido coerulescenti limbatum ; marginibus antico posticoque reflexis, postico rotundato producto (haud tuberculato vel elevato). Foeminae disco flavo-maculato. Thorax maris nigro-aeneus, lineis duabus lateribusque, et parte inferiore viridi-coeruleis. Foeminae olivaceo-aeneus : linea dorsali atra, cui adjacet utrimque linea flavescens : ad latera alia linea hujus coloris, qualis etiam pars thoracis inferior est. Abdomen ut in specie praecedente (= *A. tuberculatum*) pictum, hac tamen differentia, ut segmentum penultimum totum et ante-penultimi pars dimidia postica sint coerulei coloris. Pedes flavescentes, externa parte linea atra picti. Alae latius-culae, aqueae, pulcherrime iricolores et nervis tenerrimis instructae. Parastigmata rhombeo-quadrata, quasi rotundata : basi nigra, apice nivea ; in foeminis alba fere tota. Appendices caudales maris quatuor atrae [Tab. i., Fig. 27] superiores duae brevissimae, ad latera positae, cuneiformes. Inferiores triplo longiores, spiniformes, sub-curvatae. Ultimi segmenti abdominalis margo posticus integer et supra aequalis. Pauca tantummodo hujus Agrii specimina examini subjicere potui, ideoque fortasse descriptio posthac erit emendanda. (T. de Charpentier, "Horae Entomologicae," p. 22, 1825).

Size.

Length of Male, 28mm. to 31·5mm. ; expanse of wings, 30mm. to 34mm. Length of Female, 27·5mm. to 32mm. ; expanse of wings, 33mm. to 37mm. [From four continental specimens.]

Male Imago.

Face yellowish, with two bronze-black lines—on nasus distinct, on upper lip fainter. *Top of head* black-bronze,

with brownish ocelli. *Eyes* greenish below, brownish above, a round blue spot behind each. *Prothorax* roughly triangular, with apex, which is rounded, behind ; margins blue. Meso- and meta-thorax blue laterally, bronze-black, with two longitudinal blue stripes dorsally ; points between the wings blue. *Wings* hyaline, nervures pale brown. *Pterostigma* rhomboidal, yellow, internally dark brown on the fore-wings. *Legs* pale, with a black streak externally. *Abdomen* bronze-black ; first five sutures between segments yellow, except the first interrupted mid-dorsally ; eighth segment blue posteriorly, ninth entirely, tenth laterally ; below yellowish ; on the dorsal hind-margin of tenth segment a short, bifid tubercle, pointing backwards, yellow-tipped. *Anal appendages*, upper short, curved upwards and inwards, black above, reddish below ; lower longer, sharp, curved inwards, black above, yellowish below.

Female Imago.

With the female, in general yellow takes the place of the blue on head and thorax, while bronze replaces it on segments 8, 9, and 10 of the abdomen. On the first two segments of the abdomen the colour tends towards a yellowish-brown. The eighth segment terminates below in a spine. *Anal appendages* short, conical, orange. *Ovipositor* sharp-pointed, reaching as far as the anal appendages. *Pterostigma* pale orange.

Variation.

In var. *aurantiaca* of the female, the head, thorax (with prothorax), legs, first two segments of the abdomen, and part of the third, almost entirely orange. Nervures

russet. This variety is parallel with the orange variety of *I. elegans*. Like that insect also, *I. pumilio* varies considerably in size.

Nymph.

In "Science Gossip," September, 1894, Mr. W. H. Nunney says that the nymph resembles that of *I. elegans*, but that it has six hairs (five in figure) on the palpus, while *elegans* has eight. He adds further that the caudal lamellæ are more elliptical, that the apex makes an angle of about 35deg., and that one margin only is hairy.

Date.

This Dragonfly should be looked for from June to September.

Distribution.

As a British insect this species seems to be lost at the present time, for no locality can be given where it may now be found. But being so small, and resembling so closely *I. elegans* (especially small examples of the latter) and even *E. naias*, it may be easily passed over, considering also that Neuropterists are so few that but little of the surface of the British Isles can have been covered by them. This interesting little Dragonfly is therefore probably still with us, and diligent search should be made for it, particularly in the south of England and in Ireland. It is really a southern insect, but has been found at a considerable elevation, *e.g.*, by Mr. McLachlan, at the S. Gothard Hospice, about 6500ft. above sea-level. A few localities have

been recorded, but whether the identity of the insects taken was always satisfactorily determined I cannot say. In 1871, Mr. H. Doubleday said that it was rare in the neighbourhood of *Epping*, amongst the red gravel-pits (E. M. M., 1871, p. 87). Mr. McLachlan states in E. M. M., 1884, p. 255, that it used to be taken not uncommonly in *Dorset* by Mr. J. C. Dale, and it has also been recorded from *Cambridge* (Evans) and *Belfast* (Haliday). Mr. W. H. Bath ("Handbook," p. 79, 1890) says that it had been recorded from *Parley Heath*, in Hampshire, where it was said to be not uncommon, and that it had recently been met with near *Kilmarnock*, in Scotland, by Mr. H. S. Dunn, jun. Mr. C. W. Dale informed Mr. C. A. Briggs, in 1893, that it was common near *Penzance*, and Mr. W. H. Bath stated, in the "Naturalist's Gazette," p. 50, 1891, that it occurred sparingly in August, 1890, at a pool near *Bournemouth*. In addition to these, a *Weymouth* locality has been given, but a search there only revealed *I. elegans*. In 1887, Mr. W. H. Bath recorded a nice series from *Stratford-on-Avon* (Entom., 1887, p. 285), but as he does not give this locality in his "Handbook" (1890), we must conclude that there was some mistake. Parfitt recorded it as common near *Exeter*, but on enquiry Mr. McLachlan found that there had been an error in identification (E. M. M., 1884, p. 255).

35. Ischnura elegans, Lind.

(Plate XXIV.)

Synonymy.

Agrion elegans, Lind. Opusc. Scient. iv. 104, n. 6, t. 3, f. 5 (1823); Lind. Mon. Lib. Eur. 40, n. 9 (1825); Steph. Illustr. Brit. Ent. Mand. vi. 72 (1836); Evans Brit. Lib. 13, pl. 3, f. 3, 4 (1845); Selys Rev. Odon. 188 (1850); Hag. Ent. Ann. 59 (1857). *Ischnura elegans*, Selys Bull. Acad. Belg. (2) xli. 277 (1876); McLach. Cat. Brit. Neur. 17 (1870). *Micronympha elegans*, Kirby Syn. Cat. Neur. Odon. 142 (1890). *Agrion pupilla*, Hansem. Wiedem. Zool. Mag. ii. (1) 156 (1823); Selys Mon. Lib. Eur. 157 (1840). *Agrion tuberculatum*, Charp. Hor. Ent. 21 (1825); Burm. Handb. Ent. ii. 819, n. 11 (1839); Charp. Lib. Eur. 152, t. 38, f. 2 (1845). *Agrion cœnatum* Steph. Illustr. Brit. Ent. Mand. vi. 72 (1836); Evans Brit. Lib. 14, pl. 3, f. 5 (1845). *Agrion rufescens*, Steph. Illustr. Brit. Ent. Mand. 74 (1836), var.; Evans. Brit. Lib. 15, pl. 5, f. 2 (1845). *Agrion aglæ*, Fonsc. Ann. Soc. Ent. Fr. vii. 567, t. 15, f. 1, 2 (1838). *Agrion hastulatum*, Burm. Handb. Ent. ii. 820, n, 13 (1839). *Agrion rubens*, Evans Brit. Lib. 14, pl. 3, f. 6 (1845), var.

Vander Linden's description.

A. supra fusca, subtus virescens, puncto post oculum utrumque, lineâque utrinque longitudinali in thorace, caeruleis aut viridibus: penultimo abdominis segmento in mare (aliquando in feminâ) caeruleo. . . . Descr. Mas supra niger, puncto post oculum utrumque, lineâ utrinque longitudinali in thorace penultimoque abdominis

segmento et nonnunquam etiam primo caeruleis. Subtus, caput, oculi, pectus pallide caerulescentia, abdomen virescens apice caeruleo. Pedes pallidi, femoribus supra nigris. Alæ albæ maculâ marginali obscurâ, sæpius puncto nigro notatâ. Femina supra fusca puncto post oculum utrumque, lineâque longitudinali in thorace viridi luteis: subtus virescens. Saepe penultimum abdominis segmentum pallidius est, aliquando punctis duobus caerulescentibus notatum. Femina etiam aliquando mari simillima est, abdomine tantum crassiori. (P. L. Vander Linden, "Opuscoli Scientifici," tom. iv., p. 104, 1823).

[Vander Linden speaks of the penultimate segment (*i.e.*, the ninth) as being blue, whereas it is the eighth in *I. elegans*, and the ninth in *I. pumilio*. In his figure, however, the blue segment seems to be the eighth, and in the diagnosis he speaks of the female as sometimes having the blue segment like male, which is not the case in *pumilio*; moreover, De Selys says that all the specimens in Vander Linden's collection represented *elegans* and not *pumilio*.]

Size.

Length of Male, about 30mm. to 33mm.; expanse of wings, about 33mm. to 35mm. Length of Female, 30mm. to 33mm.; expanse of wings, 35mm. to 37·5mm.

Male Imago.

Face greenish; nasus and base of labrum black; top of head black. *Eyes* greenish; behind the eyes a circular blue spot. *Prothorax* small, black, hind-margin produced in centre in a long, raised, blunt lobe. *Thorax* black above, with a narrow blue line on each side; blue on the sides; yellowish below; projections between wings blue. *Legs* black above, bluish below. *Wings* hyaline. *Pterostigma* rhomboidal, yellow; inner bounding nervures

much darker than outer two; on fore-wings basal part of central area black; on hind-wings only lightly sprinkled with black in centre. *Abdomen*, segment 1 blue above, with black spot; 2 to 7 with 9 and 10 black above; 8 blue; sutures between segments 2 to 7 yellow, dorsally interrupted; ventral surface of 1 to 6 yellow, with mid-line black, of 7 to 10 blue. *Anal appendages* black; upper as small lobes curving outwards and downwards, and ending in a blunt point, not prominent; lower short, slender, blunt, divergent.

Female Imago.

The typical form resembles the male very closely indeed. The *pterostigma* of all the wings is like that of the hind-wings of the male; small ventral spine on distal margin of eighth segment. *Anal appendages* short, black, conical. *Ovipositor* red, rather short, reaching about to the end of the tenth segment. *Valves* with margin rounded, broad, about as long as ovipositor.

Immature Colouring.

Before maturity is reached the blue colouring is replaced by greyish-green, except in the orange variety of the female.

Variation.

Besides the marked variation in size, there is a constant form of the female in which the parts of head thorax not black, and first and second segments of the abdomen, are bright orange. On the meso- and metathorax almost the only part not orange is a broad

mid-dorsal black stripe. This form of the female is usually not at all uncommon in some localities. A specimen of this species taken in Richmond Park had two small distal blue spots on dorsal surface of seventh segment of abdomen.

Nymph.

Mr. W. H. Nunney thus describes the nymph of *Ischnura elegans* in "Science Gossip," September, 1894: "*I. elegans* usually greenish-yellow, varies greatly in colour, that of the head and eyes changing according to the creature's age. Two fasciæ occur around the basal tubercles of the antennæ; two curved lines converge towards the tubercles of the ocelli, and two other curved lines occur on the hind-borders of the head, tending medially towards the other lines, from which they are divided by a small straight line crosswise in the centre of the curved hinder margin; on the fore-face are two slight depressions, usually filled with dirt particles, consequently difficult to see. The body has on all but the final segments four curved lines arranged thus,)()(. Peculiar spines occur on the metacarpus; to see these a microscope is necessary. The caudæ are ovoid, spined along the basal upper margins, and are slightly notched where the spines end. The central tracheal stem is thickened, and is crossed at the marginal notch by an additional thickening. According to Roster, the apical angles alter with the age of the nymph." Mr. R. M. Whattson says that the lamellæ are pointed. In an empty nymph-case which I believe to belong to this species, the dark branchlets of the somewhat narrow lamella (two are lost) are very numerous.

Date.

This species begins to appear about the middle of May, and remains on the wing throughout the summer, the earliest record noticed being May 17, and the latest September 12. Quite at the end of the season specimens are often taken with the immature colouring. It does not follow, however, that these belong to a second brood; they seem rather to be individuals that have matured later, for in some species of the *Agrionidæ* nymphs taken quite near to the time when the imagines might be expected to emerge vary very greatly in size, and it is clear that the smaller ones could not possibly disclose the perfect insect till long after their larger brethren.

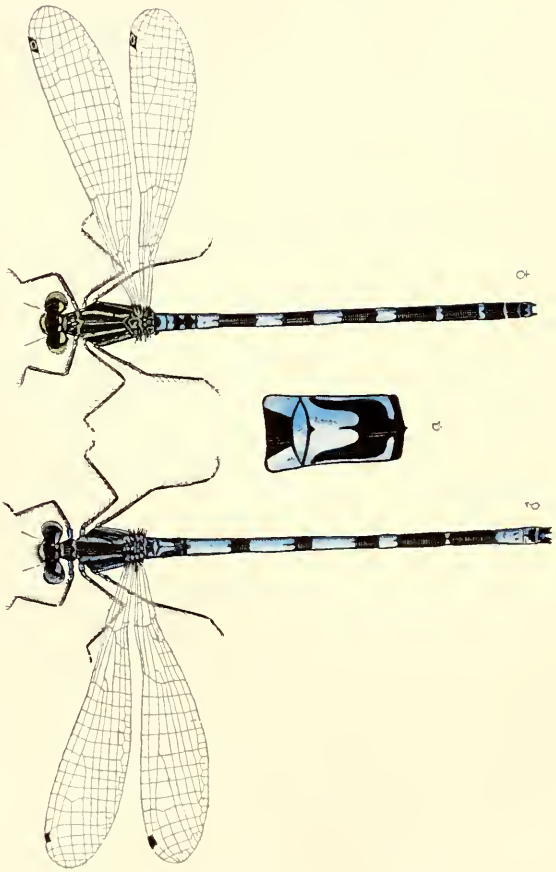
Habits.

I. elegans flies low amongst the herbage of sedgy ditches, canals, and ponds. In such situations, unless sought for, it is not easily detected, its coloration being not conspicuous.

Distribution.

Throughout the British Isles this species occurs, and though records are not very numerous, yet they are well scattered, and this Dragonfly must be looked upon as one of our common species. *Argyllshire:* Small form (G. T. Porritt); Ledaig and near Dalmally (J. J. F. X. King). *Perthshire:* (A. M. Rodger). *Lancashire:* Morecambe (G. T. Porritt). *Cheshire:* Chester district, pretty general (J. Arkle). *Yorkshire:* York, Castle Howard, and Huddersfield (G. T. Porritt).

Norfolk: Broads near Lowestoft (J. Prest). *Cambridgeshire:* Common (K. J. Morton); Wicken (G. T. Porritt); Littleport (C. A. Briggs). *Worcestershire:* Near Worcester, local (J. E. Fletcher). *Warwickshire:* Sutton Coldfield (R. C. Bradley). *Merionethshire:* Barmouth (R. C. Bradley). *Scilly Isles:* Tresco (F. Norgate). *Devonshire:* Near Plymouth (G. C. Bignell). *Somerset:* Exmoor (W. J. L.). *Dorset:* Studland (J. E. Tarbat); Glanvilles Wootton (J. C. Dale). *Hampshire:* New Forest coast near Sowley and Hengistbury Head, one (W. J. L.). *Berkshire:* Near Eynsham (W. J. L.); Radley College (M. Burr). *Middlesex:* Bushey Park and Home Park, Hampton Court (W. J. L.). *Surrey:* Ockham Common, Chobham Common, Wimbledon Common, Esher Common (one), Merton, Canal near Byfleet, near Send, and Richmond Park (W. J. L.); Kew Gardens (G. Nicholson); Virginia Water (E. Vincent). *Sussex:* Bellagio, common (M. Burr); near Liphook (W. J. L.). *Kent:* Deal, Dover, and Folkestone (C. G. Hall); Gravesend Marshes (H. J. Turner); Sandwich (W. J. L.). *Essex:* Near Epping, common everywhere (H. Doubleday, 1871); Colchester (W. H. Harwood). *Ulster:* Glasslough, Co. Monaghan (K. J. Morton). *Leinster:* Shannon Side and Coosan Point (J. J. F. X. King). *Munster:* Ross Castle, Dinish, and Denough River (J. J. F. X. King). *Connaught:* Mackree Castle, Carrowbeg River, Knappagh, Kip, and Ma'ammee Laoghs (J. J. F. X. King). *Guernsey:* Not uncommon (W. A. Luff).



Agrion pulchellum
(× 2).

36. Agrion pulchellum, Lind.

(Plate XXV.)

Synonymy.

Agrion pulchella, Lind. Opusc. Scient. iv. 103 (1823); Lind. Mon. Lib. Eur. 38, n. 7 (1825); Selys Mon. Lib. Eur. 161 (1840). *Agrion pulchellum*, Selys Rev. Odon. 197 (1850); Hag. Ent. Ann. 59 (1857); Selys Bull. Acad. Belg. (2) xli. 1255 (1876); McLach. Cat. Brit. Neur. 17 (1870). *Cœnagrion pulchellum*, Kirby Syn. Cat. Neur. Odon. 148 (1890). *Agrion puella*, Hansem. Wiedem. Zool. Mag. ii. (1) 155 (1823); Steph. Illustr. Brit. Ent. Mand. vi. 73, n. 5 (1836); Evans Brit. Lib. 14, pl. 3, f. 7-8 (1845). *Agrion interruptum*, Charp. Hor. Ent. 16 (1825); Charp. Lib. Eur. 156, t. 40 (1840). *Agrion lunulatum*, Evans Brit. Lib. 15, pl. 4, f. 3 (1845). *Agrion hastulatum*, Evans Brit. Lib. 15, pl. 4, f. 5, 6 (1845). *Agrion cyathigerum*, Evans Brit. Lib. 15, pl. 4, f. 7 (1845).

Vander Linden's description.

Under *Agrion platypoda* (=*Platycnemis pennipes*) Vander Linden says: N.B. Feminam adhuc possideo, corpore supra fusco, maculis duabus postice in capite, lineolâque intermediâ; fasciâ utrinque longitudinali in thorace, maculisque duabus connatis ad basin segmentorum abdominis, cæruleis; primo atque antepenultimo segmento totis fere cæruleis, maculâ irregulari nigrâ, duabusque ultimis supra nigris: subtus virescente, pectore cinereo: alis albis, maculâ marginali fuscâ: pedibus pallidis supra nigris. Cum nunquam in copulâ ceperim, dubito an

species distincta sit. Intermedia videtur inter *Agr. platypodam* et *Agr. puellam.* ("Opuscoli Scientifici," tom. iv., p. 103, 1823). . . . In 1825, he says:—vii. *Agrion pulchella.* A. Capite et thorace suprà nigris, macula post oculum utrumque, strigaque utrinque thoracis, cæruleis aut violaceis: abdomine fusco-æneo, segmentis plurimis basi cæruleis. . . . *Mas.* Caput suprà nigrum, macula post oculum utrumque, et lineola intermedia, cæruleis: anticè cæruleum, strigis duabus transversis nigris. Oculi fusci subtùs cærulei. Thorax suprà niger, striga utrinque longitudinali cærulea, aliquando interrupta: subtùs lateribusque cæruleus. Abdominis primum segmentum cæruleum; 2, cæruleum macula bifida nigra; 3, 4, 5, 6, nigro-ænea, macula baseos cærulea; 7, nigro-æneum; 8, cæruleum; 9, cæruleum posticè nigrum; 10, nigrum. Pedes nigri, femoribus extùs, tibiis intùs, cæruleis. Alæ albæ, macula marginali obscura, puncto nigro. *Femina.* Caput, thorax, pedes, alæ ut maris. Abdominis segmenta, 3, 4, 5, 6, 7, 8, nigro-ænea macula baseos cærulea; 9, 10, nigro. Variat etiam abdominis segmentis, 3, 4, 5, 6, 7, nigris immaculatis: 8, macula baseos virescente. Long 14 lin. Ext. alar. M. 16 lin. F. 19 lin. ("Monographiæ Libellulinarum Europæarum Specimen," p. 38, 1825).

Size.

Length of Male, 32mm. to 36·5mm.; expanse of wings, 36mm. to 41mm. Length of Female, 34mm. to 36mm.; expanse of wings, 44mm. to 50mm.

Male Imago.

Face bluish; black line at base of labrum and on suture between nasus and frons. *Eyes* bluish. *Top of*

head black-bronze; a comma-shaped blue spot behind each eye; broken, blue, transverse streak on occiput. *Prothorax* black-bronze, with blue line along front margin; strongly trilobed behind, and edged with blue in middle of margin. *Thorax* black-bronze above, with two blue longitudinal stripes; bluish below; projections between wings blue. *Wings* hyaline. *Pterostigma* small, rhomboidal, black centre, pale between centre and black bounding nervures. *Legs* black above, bluish below. *Abdomen* blue and black-bronze; segment 1 blue, with

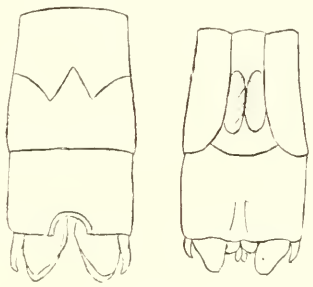


Fig. 48. Anal Appendages of Male of Agrion pulchellum. Dorsal and Ventral Surfaces.
(After Hagen, in De Selys' "Revue.")

squarish posterior spot; 2, blue, with U-shaped spot (Plate XXV) joined to black circlet behind it; 3 to 5, blue, with distal spot extending forward as a line in centre and on sides; 6, with a small basal spot only blue; 7, black-bronze; 8, blue; 9, blue, with large three-pointed black-bronze distal spot; 10 black-bronze, blue at sides, hind-margin deeply notched; underside, middle segments greenish, others bluish. *Anal appendages* (Fig. 48), upper, globular, bluish or yellowish, with rather long,

sharp, black projection pointing downwards and outwards ; lower, somewhat similar in shape and colour, with projection pointing upwards and outwards.

Female Imago.

Eyes greenish. Middle lobe of *prothorax* not so prominent as in male. Segment 2 of *abdomen* blue, with a black-bronze spot much resembling that on the second segment of the male of *Agrion mercuriale ;* 3 to 8 black-bronze, with a basal bilobed blue spot ; 9 and 10 bronze-black, with margins blue ; underside yellowish, mid-ventral line black. In other respects, and in general appearance, the female resembles the male more closely than in the other British Agrions. *Anal appendages* short, conical, black. *Ovipositor* reddish, as long as the ninth and tenth segments. *Valves* bluish.

Immature Colouring.

At first grey, then passing through lavender and violet-blue to a cold cerulean-blue like the rest of the genus ; wings with a slight brown tinge ; pterostigma paler ; the black parts with a more decided bronze tinge.

Variation.

The stripes on the dorsal surface of the thorax vary in development, and may or may not be interrupted towards their basal extremity. The characteristic spot on the second segment of the male varies, especially in thickness, and the neck joining it to the circlet behind may possibly be absent ; there is also great difference in the development of the blue spots. A

form of the female which resembles somewhat closely the female of *A. puella* has the blue spots reduced to mere circlets. The shape of the prothorax will in such cases serve to distinguish the two species, which seem to be closely related.

Nymph.

On one occasion the author bred an imago of this species, but could not make out any clear points of distinction between the nymph-case and that of *A. puella*. Perhaps had he known previous to emergence to what species the nymph belonged, this might have been possible.

Date.

Early in May this insect appears on the wing in Surrey, and it has been recorded as abundant in the middle of July in Cambridgeshire. There is little doubt that, like its congeners, it extends into August.

Habits.

In its haunts and manner of flight it seems to resemble its congener, *A. puella*, the male of which also, and of *E. cyathigerum*, it closely resembles in appearance.

Distribution.

Judging by the records and notices of its occurrence, this Dragonfly does not appear to be so common as is generally supposed. The author has met with it but in one district, and there only in comparatively small numbers. Records are: *Argyllshire:* (J. Mackay, "Young Naturalist," vol. viii., p. 180). *Yorkshire:*

Castle Howard (G. C. Dennis); Askern and Sandburn (G. T. Porritt). *Warwickshire:* Stratford-on-Avon (W. H. Bath). *Cambridgeshire:* Ouse, near Ely, abundant, and Littleport (C. A. Briggs); Wicken, abundant (G. T. Porritt). *Norfolk:* Broads near Lowestoft (J. Prest). *Essex:* Near Epping, not common (H. Doubleday, 1871). *Kent:* Deal (C. G. Hall); Canterbury (H. M. Briggs). *Sussex:* East, common in woods and lanes (G. T. Porritt). *Surrey:* Ponds, &c. (W. J. Ashdown); canal, near Byfleet (W. J. L.); Ockham Common, one (W. J. L.).* *Dorset:* Glanvilles Wootton (C. W. Dale). *Ulster:* Armagh (J. J. F. X. King). *Guernsey:* Grande Mare, common (W. A. Luff).

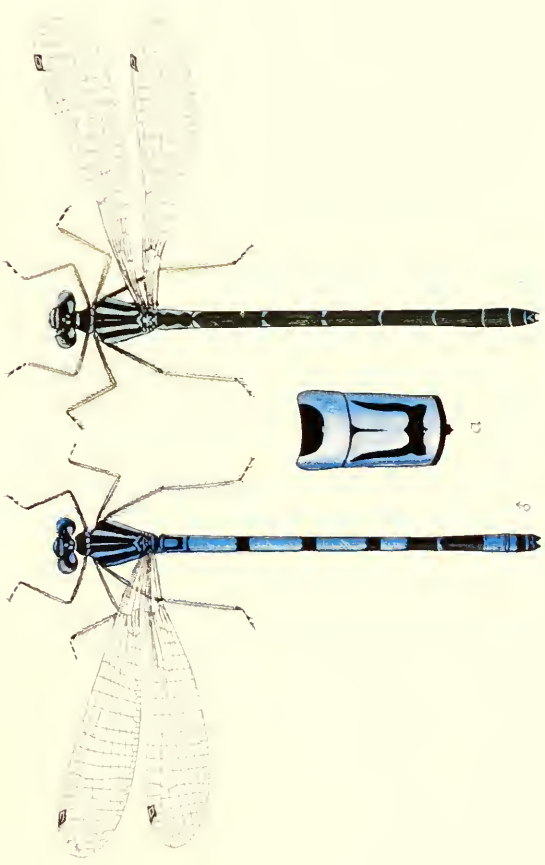
37. Agrion puella, Linn.

(Plate XXVI.).

Synonymy.

Libellula puella, Linn. Syst. Nat. i. 546, n. 18 (1758); Linn. Faun. Suec. 375 (1761). *Agrion puella*, Lind. Opusc. Scient. iv. 104, n. 5 (1823); Lind. Mon. Lib. Eur. 39 (1825); Selys Mon. Lib. Eur. 163 (1840); Selys Rev. Odon. 200 (1850); Hag. Ent. Ann. 60 (1857); McLach. Cat. Brit. Neur. 17 (1870); Selys Bull Acad. Belg. (2) xli. 1257 (1876). *Cœnagrion puella*, Kirby Syn. Cat. Neur. Odon. 148 (1890). *Agrion furcatum*, Charp. Hor. Ent. 18 (1825); Charp. Lib. Eur. 158, t. 40 (1845); Steph. Illustr. Brit. Ent. Mand. vi. 73, n. 8 (1836); Evans Brit. Lib. 14, pl. 4, f. 1, 2 (1845).

* In some of the magazines the author, by mistake, recorded the capture of this species on Esher Common; it does not appear to occur there.



Agrion puella
(× 2).

Agrion pupa, Hansem. Wiedem. Zool. Mag. ii. (1) 155 (1823). *Agrion annulare*, Steph. Illustr. Brit. Ent. Mand. vi. 74, n. 8 (1836) ; Evans Brit. Lib. 15, pl 5, f. 1 (1845). *Lucifugus* (?) Harr. Expos. Eng. Ins. 98, t 29, f. 5, 6 (1782).

Linnæus' description.

L. alis erectis hyalinis. (*α*). Libellula corpore sericeo, alis puncto marginali fusco. . . . (*β*). Libellula corpore incarnato, alis puncto marginali fusco. . . . (*γ*). Libellula corpore sericeo, alis puncto marginali nigro. . . . (*δ*). Libellula corpore cæruleo cinereoque alterno, alis puncto marginali nigro. . . . Varietates conjunxi, quas copula sæpius junctas vidi. (C. Linnæus, "Systema Naturæ," Ed. x. I., p. 546, n. 18, 1758.) *LIBELLULA puella* alis erectis hyalinis. (*α*). Libellula corpore sericeo ; alis puncto marginali fusco. DESCR. Hæ e minoribus. *Dorsum* secundum totam longitudinem æneum. *Alæ* auratæ, nitidæ, puncto marginali fusco, rhomboide, non nigro : vasa alarum reticulata constant semper duobus nervis longitudinaliter sibi propioribus. *Thorax* et *abdomen* subtus et ad latera livida. *Pedes* extra nigricantes, intus lividi. *Oculi* cinerei, supra fusci. *Caput* a tergo æneum, linea alba transversa, transversim trifida, extremitatibus crassioribus. *Thorax* a tergo viridi-æneus, utrinque linea alba longitudinali notatus. *Antennæ* nigræ, breves, infimo articulo crasso. . . . (*β*). Libellula corpore incarnato ; alis puncto marginali fusco. DESCR. *Corpus* incarnatum, juxta incisuras abdominis lineolis sive characteribus nigris. *Punctum* alarum marginale fuscum. . . . (*γ*). Libellula corpore sericeo ; alis puncto marginali nigro. DESCR. *Alæ* albæ

puncto marginali atro. *Corpus* supra viridi-cæruleum, nitidum, absque ulla alia mixtura; magnitudo præcedentium duarum. . . . (δ). Libellula corpore cæruleo cinereoque alterno; alis puncto marginali nigro. DESCR. *Alæ* albæ, puncto marginali atro. *Abdominis* articuli a tergo visi antice cinerei, postice cærulescenti-nitidi; antepenultimus et ultimus articulus in plerisque cinereus, nullo modo nitidus. (C. Linnæus, "Fauna Suecica," ed. ii., pp. 375-376, n. 1471, 1761.)

[(α) appears to be *A. puella*, female. (β) is, no doubt, *Pyrrhosoma nymphula*. (γ). The identity of this insect does not seem clear. (δ) appears to be *Enallagma cyathigerum* or *A. puella*, male.]

Male Imago.

Face bluish; a black line at base of labrum, and another at base of nasus. *Top of head* black-bronze, with a comma-shaped blue spot behind each eye; under-surface of head blue. *Prothorax* black-bronze, three-lobed, but not deeply cut or much raised, middle division lightly notched in centre, edged all round with blue. *Thorax*, dorsal surface black-bronze, with two entire, blue, longitudinal stripes; sides and lower surface blue, projections between wings blue. *Wings* hyaline; *pterostigma* black, centre surrounded by pale ring, and bounded by stout nervures. *Legs* black above, bluish below. *Abdomen* blue and bronze-black; segment 1, blue, with somewhat semicircular basal black spot; 2, blue, with U-shaped spot not reaching the circlet behind it (Plate XXVI.); 3 to 5 blue, with distal quarter black; 6, blue, with distal half black; 7, all except narrow basal ring black; 8, blue, with two tiny black spots; 9, blue, with distal three-pointed black spot; 10, black, with

anterior edge blue, hind-margin notched and there edged with blue ; on 3 to 6 a fine black lateral line extending from the black spot forward along the greater part of the segment ; lower surface bluish, with black mid-ventral line. *Anal appendages* (Fig. 49), upper smaller, swollen

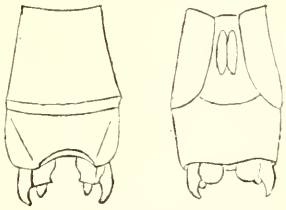


Fig. 49.—Anal Appendages of Male of Agrion puella.
Dorsal and Ventral Surfaces.
(After Hagen, in De Selys' "Revue.")

at base, with a small pointed projection turning downwards and slightly inwards ; front of swollen part yellowish, rest black ; lower, broad and flattened at base, yellowish, then narrower, turning upwards and outwards, twisted, point turned inwards.

Female Imago.

Head, *thorax*, *wings*, and *legs* as in the male, except that the blue colour is replaced by a greenish tint. *Prothorax* is very little notched or raised behind. *Abdomen* black-bronze and greenish, black covering nearly the whole of the upper surface ; on segment 1, a large, somewhat semicircular spot attached to the hind-margin ; 2, with thistle-shaped spot ; 3 to 6 black-bronze, with a narrow bluish-green circlet interrupted mid-dorsally ; 7 to 10 bronze, but circlets between them bright blue, not interrupted ; hind-margin of 10 notched and

edged with bluish; lower surface yellowish-green, with black mid-ventral line. *Anal appendages* short, pointed, dark. *Ovipositor* red, reaching about the end of the tenth segment. *Valves* bluish-green.

Immature Colouring.

In reaching maturity a similar series of colour-changes is passed through to that mentioned in the case of *A. pulchellum*.

Variation.

In the male the sides of the U on segment 2 are sometimes separated from the base, so that the spot consists of three lines. The blue spot on segment 6 varies in size, and the black spot on segment 9 is sometimes quite divided so as to make two lateral spots. The female sometimes has the green parts altered to a decided bluish tint. The pale circlet at the sutures may on some segments develop into basal bifid spots, and the bronze spot on segment 2 take the form of the mercury-spot in the male of *A. mercuriale*, in which case it is difficult to distinguish the insect from a female of *A. pulchellum*, except by the hind-margin of the prothorax.

Nymph (Fig. 50).

In shape long and slender; length, including caudal lamellæ, about 22mm.; greatest breadth about 2·5mm. General ground-colour yellowish-green, points and markings reddish-brown. *Head* a flattened pentagon; transverse measurement about 4mm.; longitudinal about 2mm.; lateral edges sloping backwards considerably.

Antennæ seven-jointed, the distal one being very small, basal two stout, others slender; second dark basally. *Mask* flattish, triangular, narrow at hinge; middle lobe produced in an obtuse angle, and lightly toothed; palpi with a row of teeth along the distal edge, the inner one being rather larger than the rest; the sharp, slender

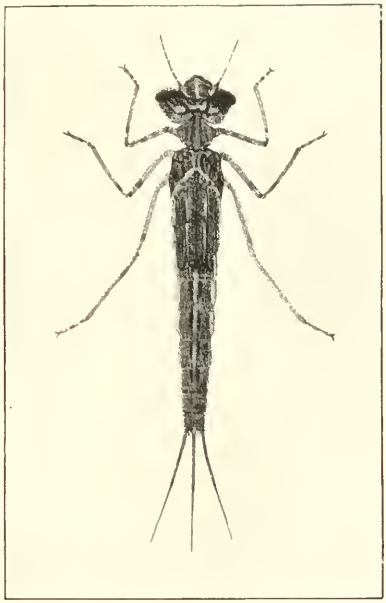


FIG. 50.—NYMPH OF AGRION PUELLA.
(× 3.)

outer movable hooks interlacing when the mask is at rest; mask extending to the insertion of the fore-legs; a row of hairs near the outer margin of the palpi, and an interrupted half-circle on the body of the mask. *Eyes* rather dark olive-brown, large, somewhat elliptical

in shape, major axis almost transverse. *Top of head* with some palish spots. *Occiput* rather broad; hind-margin somewhat deeply hollowed, covered with reddish-brown points. *Prothorax* pentagonal, of fair size. *Meso-thoracic spiracles* visible, dark. *Thorax* covered with reddish-brown points. *Wing-cases* straight, of fair length, about 4mm. *Legs* pale; fore- about 5mm. long, mid- 6·5mm., hind- 9mm., with rows of reddish-brown points; a dark ring on femora and another on tibiæ near the basal joint; a few very fine hairs on tibiæ. *Abdomen* tapering posteriorly; joints fairly equal; each, except the tenth, bearing on its posterior margin a row of dark dots; on segments as far as the eighth a paler lateral line, and a similar mid-dorsal one bounded on each side by a dark red-brown line, widest at the base of the segment and tapering to the distal margin; the rest of the abdomen covered above with reddish-brown points, which are rather conspicuous along the lateral margins of the segments. *Caudal lamellæ* about 6mm. long, without markings, but with a ramification of tracheæ. [Bred on several occasions. The lamellæ were usually lost before emergence; nevertheless they appear to be always pointed, though some authors have described them as rounded at the tip.]

Emergence of Imago.

On one occasion an imago was detected in the act of emerging from the nymph-case. Head, thorax, wings, legs, and the greater part of the abdomen were out. The insect appeared to be just at the end of the "resting" period. It was then erect, as described in the case of *Pyrrhosoma nymphula*. It may, of course,

have thrown itself back earlier, as *Libellula quadrimaculata*, &c., do, but probably did not. The part of the development observed agreed with that described for *P. nymphula*.

Date.

May 3 is the earliest date on which I have taken the species, and August 16 the latest. It is at its best about midsummer.

Habits.

A. puella haunts the vegetation by the sides of ponds and ditches, and the long grass and rushes of damp meadows near water. Like the rest of the *Agrioninæ* its flight is weak and not long sustained.

Distribution.

Undoubtedly *A. puella* is a very common species in most parts of England, but apparently it does not occur in Scotland, and perhaps not in the extreme North of England. But few records have come to hand, owing no doubt to the fact that observers think it unnecessary to record localities for common species—a mistaken idea, but a very prevalent one. *Westmoreland:* Windermere, in immense abundance (W. H. Bath)*. *Yorkshire:* Selby, Thorne, Askham Bog, and Castle Howard (G. T. Porritt). *Cheshire:* Chester District, general (J. Arkle). *Merionethshire:* Tan-y-bwlch, common, and Barmouth (A. D. Imms). *Cambridgeshire:* Not common (K. J.

* Entom. 1888, p. 62. In his "Handbook," p. 76 (1890), Bath says of *E. cyathigerum* that it was in "immense swarms" in the same district. Though both species fly together sometimes, it is not usual to find both swarming near the same piece of water.

Morton) ; Wicken (G. T. Porrit). *Norfolk:* Broads, near Lowestoft (J. Prest). *Worcestershire:* Near Worcester (J. E. Fletcher). *Warwickshire:* Sutton Coldfield, common (R. C. Bradley) ; Birmingham District, common (A. D. Imms). *Oxfordshire:* Cowley Marsh and Shotover Hill (A. H. Hamm) ; Brighthampton (Mr. Stone, in Oxford Museum) ; near Yarnton (H. R. Smith, in Oxford Museum). *Berkshire:* Maidenhead (G. T. Porritt). *Hampshire:* New Forest, common (R. McLachlan). *Dorset:* Glanvilles Wootton (C. W. Dale). *Surrey:* Ockham Common, Chobham Common, Esher Common, Bookham Common, near Send, Oxshott, Byfleet Canal, and Longcross (W. J. L.); Weybridge (J. E. Tarbat) ; Richmond (H. J. Turner). *Sussex:* East, common in woods and lanes (G. T. Porritt) ; near Liphook (W. J. L.). *Kent:* Deal and Dover District, common (C. G. Hall). *Essex:* Near Epping, common (H. Doubleday) ; Colchester (W. H. Harwood). *Devon:* Bovey Tracey (A. H. Hamm) ; Lynmouth (C. A. Briggs) ; near Plymouth (G. C. Bignell). *Leinster:* Killucan and Moate (J. J. F. X. King). *Munster:* Ross Castle (J. J. F. X. King). *Connaught:* Carrowbeg River and Knappabeg Laogh (J. J. F. X. King). *Guernsey:* one (W. A. Luff).

38. Agrion mercuriale, Charp.

(Plate XXVII.)

Synonymy.

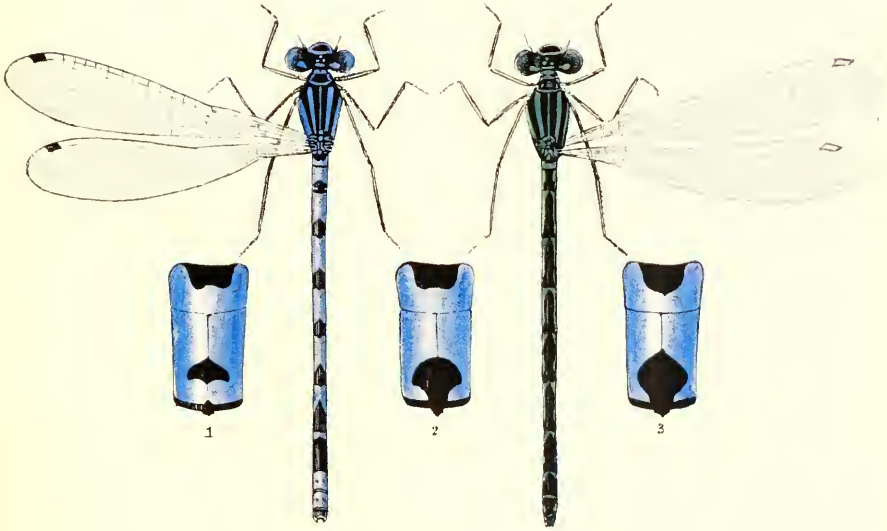
Agrion mercuriale, Charp. Lib. Eur. 159, t. 42, f. 2 (1840); Selys Rev. Odon. 221 (1850). Hag. Ent. Ann.



Agrion mercuriale

(× 2).

SEGMENTS 1 AND 2 (much enlarged).



Enallagma cyathigerum

(× 2).

2, NORMAL MARKING OF SEGMENTS 1 AND 2; 1 AND 3, EXCEPTIONAL MARKING (much enlarged).

60 (1857); McLach. Cat. Brit. Neur. 18 (1870); *Cænagrion mercuriale*, Kirby Syn. Cat. Neur. Odon. 150 (1890). *Agr. puella*, Fonsc. Ann. Soc., Fr., 563 (1838). *Agr. fonscolombii*, Ramb. Ins. Névr. 266 (1842).

Charpentier's description.

Caput ut in praecedentibus; temporibus valde tumidis, vertice atro-viridi, maculis duabus lateralibus et linea intermedia coeruleis (aut virescentibus) in occipite, *Truncus*. Prothorax perbrevis, antice angustatus, postico margine in media parte paullisper ascendente, atro-viridis, undique coeruleo-marginatus. Alitruncus ut in Agr. furcato (= *Agrion puella*). *Abdomen* maris coeruleum, superne maculis atro-viridibus, in aeneum colorem conversis. Segmentum primum maculam quadratam, magnam habet. Secundum insigne est macula magna, antice cornua tria referente, medio brevissimo, lateralibus longioribus, curvatis (vid. figuram fundamentalem, Tabulae XLII. adiectam): postice quasi petiolo armata, et ad marginem segmenti ipsum dilatata, quae haud inepte cum signo Mercurii chemico comparari potest. Segmentum tertium postice macula magna, biloba, lobo anteriore angustiore, acuminato. Quartum, quintum et sextum macula magna postica, antice triacuminata; in his segmentis intermediis macula atro-viridis dimidiam fere dorsi partem implet. Septimum superne atro-viride fere totum. Octavum coeruleum, punctis duobus posticis atris. Ultima segmenta superne atra. Foeminae abdomen subtus virescens, superne atro-viridi-maculatum: in segmento primo macula magna, quadrata, atra. Secundum macula magna, oblonga, biloba, marginem anticum non attingente, instructum est: reliqua segmenta

maculis dorsum fere implentibus, in medio paullulum angustioribus. (T. de Charpentier's "Libellulinae Europaeae," p. 159, t. 42, f. 2.)

Size.

Length of Male, 27mm. to 31mm.; expanse of wings, 31mm. to 35·5mm. Length of Female, 29mm. to 31mm.; expanse of wings, 35mm. to 39mm.

Male Imago.

The *Head* resembles that of *A. puella*, except that the blue spot behind the eyes is almost round. *Prothorax* blackish-bronze, with a blue spot on each side, and a blue border on all four sides, but slightly interrupted at the middle of the hind margin. The *meso-* and *meta-thorax* also closely resemble the same parts in *A. puella*. *Legs* black above, blue below. *Wings* hyaline; pterostigma diamond-shaped with blackish centre, succeeded by a hyaline ring, and that by a black border. *Abdomen* blue above and below, marked with black-bronze on the upper surface, as follows: On the first segment a squarish black spot, on the second one resembling the usual sign for the planet Mercury (Plate XXVII., *c*); the next four segments have spots at the hinder end, prolonged in front into a lanceolate point in the third and fourth, and sometimes in the fifth, and even the sixth. The seventh segment is almost entirely black, and the eighth is blue, usually with two tiny spots; the ninth has the posterior half black, bordered behind with blue; and the tenth is black, notched behind, and there edged with blue. The *appendages* are about as long as the tenth segment, and

their peculiar shape will be seen from Fig. 51, the roundish lobe being blue, the rest chiefly black. The spot on the second segment somewhat resembles that

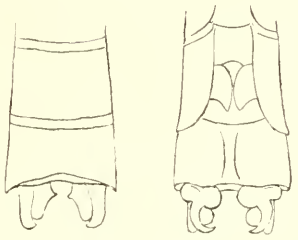


FIG. 51.—ANAL APPENDAGES OF MALE OF AGRION MERCURIALE.
Dorsal and Ventral View.
(After Hagen, in De Selys' "Revue.")

on the second segment of the female of *A. pulchellum*, but the size and the sex should determine the species.

Female Imago.

In the female the blue colouring is replaced by greyish-green, except for the hinder edge of the seventh and eighth segments, which is in each case bright blue. The black-bronze spots nearly fill the dorsal surface, except a band along the anterior edge: the spot on the second segment is thistle-shaped; the centre of the pterostigma is rather pale brown. The smaller size, the circular spot behind the eyes and the blue margin to the seventh and eighth segments should be sufficient to distinguish the female of this species from that of *A. puella*, which it in other respects closely resembles.

Immature Colouring.

The male passes through the same yellow, grey and

lavender tints in reaching maturity as does *A. puella* or *E. cyathigerum*.

Variation.

There is considerable difference in size, especially among the males, two that I took in the New Forest in August, 1898, being particularly small. In addition to this the shape of the various spots, and the amount of the segment which any particular one covers, is very inconstant. The distinctive spot on the second segment is sometimes lightly, and at others heavily, delineated; its method of attachment to the circlet posterior to it, or the absence of the attachment, might cause the insect to be confused with *A. pulchellum* on the one hand, or *A. puella* on the other, if the examination of the insect were too cursory.

Oviposition.

Attention has been called by Mr. McLachlan to an interesting fact in connection with this insect. In Savoy, in 1884, the season being very dry, he saw the females of certain Agrions, chiefly *A. mercuriale*, ovipositing in wet mud, which proceeding he was led to discover by noticing that certain of them "when flying were conspicuous on account of the whitish colour of the whole, or a portion, of the abdomen. On examination these proved to be always females, and the whitish colour due to an incrustation of mud; in some it was only at the tip of the abdomen, in others for its whole length (nearly an inch). The explanation was obvious. These females had been engaged in oviposition, and some instinct had prompted them to sink their eggs as deeply as possible in the mud, so as to afford some chance of

escape from the consequence of further evaporation." * The *mercuriale* that I met with in the New Forest seemed to prefer fast running streams rather than muddy ditches, though of course they may not oviposit in the former, for there was a bog close at hand, on which indeed several were seen.

Date.

Mr. McLachlan has taken it in June† in the New Forest, and I have myself found it there as late as August 14, when it was by no means over.

Nymph.

Length, including caudal lamellæ, 16mm.; *width* of abdomen 1·75mm. *Head*, somewhat pentagonal, rather narrow from front to back. *Eyes* rather large, in position and shape resembling those of *P. nymphula*. *Antennæ* seven-jointed, basal two joints stout, rest slender, second and third long, others decreasing to tip, distal one small; a ring of hairs round the more slender joints near apical end. *Mask* flat, of the usual Agrionine shape, extending to the insertion of the first pair of legs; palpi bearing a row of hairs near the outer margin; part of a circle of hairs on body of mask; middle lobe making nearly a right angle, margin serrated; tip of palpus with inner point sharp, and outer cut squarish and notched; movable hook long, curved, sharp. A double pale spot on *top of head*, and some brown markings, but not definite on the empty case. *Occiput* appears to be very narrow in centre with dark marks on front margin; sides sloping

* E. M. M., 1885, p. 211. † E. M. M. 1896, p. 181.

much backwards, and covered with rough points; hind-margin concave. *Prothorax*, shape much as in *E. cyathigerum*, dark lateral corners. *Meso-thoracic spiracles* dark, exposed in empty skin. *Thorax* covered with dark points. *Wing-cases* about 4mm. long. extending nearly to the fourth segment. *Legs* very pale; apical end of distal joint of tarsus darker; length of fore-legs about 5mm., of mid-legs 5·5mm., of hind-legs 7mm. *Abdomen* pale; an indication of a paler line down centre, with a very slightly darker margin, which is a little more pronounced at the sutures; there are indications of a slight spot on each segment in the browner line outside the pale mid-dorsal one; near each lateral carina is a line of dark spots at the sutures; a line of points round the hind margin of the tenth segment. *Caudal lamellæ* very short, length 3mm.; the right hand one was lost; possibly the other two are newly-grown ones, but they hardly appear to be so, if not the size will distinguish the species from other Agrions; pointed, narrow, width about $\frac{1}{5}$ of length; mid-rib stout, branches few and not easily seen; margins spined as far as cross-line, hairy thence to the tip; cross-line about a third of length from tip. [From a New Forest nymph taken amongst some *Platycnemis pennipes*, but unrecognised. It produced a male imago on June 23. The description was therefore made from an empty nymph-case, which was very transparent, and of a pale brown colour.]

Habits.

A. mercuriale in the New Forest flies low and slowly amongst the herbage along the margins of streams or over boggy ground near them.

Distribution.

The only known habitat of this species in the British Isles is the New Forest, in Hampshire. Here in two or three centres connected with the Lymington river it may be found, and at least in one of them rather commonly. In this last locality the insect seems luckily to have a strong hold, and consequently there is little fear of its extermination in the near future. If strict search were made it would probably be found in fresh spots in the Forest, and perhaps in other parts of the South of England and Ireland also. On the wing, *A. mercuriale* closely resembles *A. pulchellum*, *A. puella*, and *A. cyathigerum*, its near relatives, and perhaps this resemblance may sometimes cause it to be passed over unnoticed. Mr. C. W. Dale has in his collection specimens from Glanvilles Wootton, in Dorset, and from Winchester, but the locality at the former place has now been drained, and that at the latter is no longer known.

39. Enallagma cyathigerum, Charp.

(Plate XXVII).

Synonymy.

Agrion cyathigerum, Charp. Lib. Eur. 163, t. 42, f. 1 (1840); Selys Rev. Odon. 205 (1850); Hag. Ent. Ann. 60 (1857); McLach. Cat. Brit. Neur. 18 (1870). *Enallagma cyathigerum*, Kirby Syn. Cat. Neur. Odon. 145 (1890). *Agr. hastulatum*, Steph. Illustr. Brit. Ent.

Mand. vi. 74 (1836) [name preoccupied]. *Agr. pulchrum* ♀, Hag. Syn. Lib. Eur. 80 (1840). *Agr. charpentieri*, Selys Rev. Zool. 214 (1840). *Agr. brunnea*, Evans, Brit. Lib. 15, pl. 4, f. 8 (1845). *Aereus* (?) Harr. Expos. Eng. Ins., t. 29, f. 3, 4 (1782).

Charpentier's description.

"*Caput* ut in congenericis. *Truncus.* Prothorax triangularis, margine postico pauxillum rotundato; undique coeruleo-limbato; maculis duabus lateralibus coeruleis, distinctis. Alitruncus atro-aeneus, lateribus coeruleis: in collari strigae duae valde distinctae, coeruleae. Reliquae alitrunci partes, sicuti alae et pedes, uti in specie praecedente [= *Ag. lunulatum*] comparatae. *Abdomen* paullo longius et gracilius, quam in *Agr. lunulato:* coeruleum. In segmento marium primo macula est basalis minima, atra. Secundum habet marginem posticum atrum, et in parte postica maculam magnam, orbiculatam, atram, stylo cum margine postico segmenti cohaerentem. Similes maculae in segmentis tertio et sequentibus usque ad septimum, maculae autem in his sunt magis elongatae, et in posticis acuminatae, longiores. Octavum et nonum segmentum coeruleum totum. Decimum superne atrum, postice profunde excisum— Foeminarum segmentum primum uti in maribus est comparatum: secundum insigne est macula antice posticeque margini annata, antice paullulum latiore, et ad postica, ante finem, in lobulum orbicularem dilatata. Sequentia segmenta media macula magna, elongata, antice acuminata, postice, ante finem, dilatata picta sunt. Septimum et octavum postice atro-viridia fere tota, qui color acumine tenui marginem

segmenti anticum tangit. Ultima duo segmenta in medio dorso atra. *Appendices* marium superiores brevissimae, vix extra abdomen conspicuae, globulares, subpilosae, fuscae. Inferiores longiores, laterales curvatae cylindricae, atrae. Foeminarum appendices brevissimae, conicae, obtusae, et (ut videtur) coerulescentes." (T. de Charpentier's "Libellulinae Europaeae," p. 163, pl. xlii., f. 1, 1840).

Size.

Length of Male, 31mm. to 33mm.; expanse of wings, 36mm. to 39mm.; Length of Female, 29.5mm. to 33mm.; expanse of wings, 37mm. to 40mm.

Male Imago.

Head blackish-bronze above, face and eyes blue; two pear-shaped blue spots on the occiput, with their tails pointing towards the middle line. *Prothorax* triangular, rounded behind; it is bordered in front with blue, and much more narrowly behind, while there is a blue spot on each side. *Meso-* and *meta-thorax* blue, the upper surface of the former with three black bands, a broad medio-dorsal one, and a narrower one on each side. *Wings* hyaline; the diamond-shaped pterostigma black. *Legs* black above, greenish-blue below. *Abdomen* blue, with bronze-black markings, whose arrangement will be best seen from the figure. The second segment bears an elliptical spot (Plate XXVII., *b*), usually connected with the hind marginal circlet, this spot affording a ready means of distinguishing the species. Lower *anal appendages* rather long and slender, turned in at the point, which is

rather sharp. They are longer than the upper ones, and all are blackish in colour (Fig. 52).

Female Imago.

In the female the blue colour is replaced by greyish-green. The upper surface of the *abdomen* bears on segments 3 to 8 a bronze-black spot, somewhat conical in shape but with curved sides; the base of these spots is posterior, consequently the ground-colour is left visible at the anterior part of each segment near the preceding circlet. On the second segment the spot is thistle-

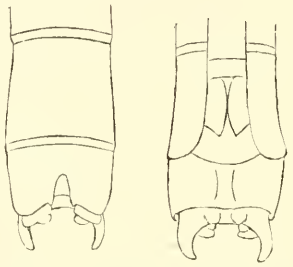


Fig. 52.—Anal Appendages of Male of Enallagma cyathigerum.
Dorsal and Ventral View.
(After Hager, in De Selys' "Revue".)

shaped, while on the ninth and tenth segments it occupies almost the whole of the upper surface. *Anal appendages* reddish. *Vulvar scales* rather small. The hind-margin of the eighth segment terminates below in a stout black spine.

Immature Colouring.

When newly disclosed the perfect insects are of a dingy yellow colour. In the male this soon becomes

pale lavender with dark grey spots, and ultimately bright blue with blackish-bronze spots. In the female it becomes greyish-green with bronze spots.

Variation.

The spots vary somewhat in shape, and the distinctive one on the second segment of the male is sometimes reduced to a mere transverse streak, quite disconnected from the circlet (Plate XXVII., *c*); onthe other hand, the front margin of the spot is often produced into a short point (Plate XXVII., *a*). On the Continent these variations (the former especially) sometimes lead to confusion with neighbouring species. In the female the ground-colour is sometimes blue, as in the male, instead of greyish-green. Charpentier figures* this as the typical form, but my experience bears out the opinion of De Selys† that it occurs much more rarely than the greenish form.

Oviposition.

From the colour and markings it was probably a female of *E. cyathigerum* that the writer was able to observe ovipositing near Byfleet, in Surrey, on July 16, 1898. A pair of Agrionines, united *per coll*, settled on a water-weed, and shortly afterwards the female was noticed descending below the surface, one or two inches at least, and she appeared to be ovipositing. On an attempt being made to catch the male, which was hovering over the spot, she was frightened, and came to the surface. She did not seem to be wetted, but was

* "Libellulinæ Europææ," tab. xlii., fig. 1.

† "Revue des Odonates," p. 208.

surrounded with a coating of air, the surface-film of the water next which glistened like silver. She appeared to lay some eggs, or, at any rate, dip the end of her abdomen before descending, and even while flying.

Egg.

In shape closely resembling that of *Æ. juncea*; length about 1mm., breadth about ·2mm.; spindle-



Fig. 53.—Mask of Nymph of Enallagma cyathigerum.
(Much magnified.)

shaped, more pointed at one end than at the other, rather broader near the sharp end; transparent, or very nearly so, and colourless; granular in structure. [The eggs were taken from a female captured about the middle of September. They were few in number, no doubt owing to the lateness of the date.] (Fig. 4, No. 6.)

Nymph.

Colour bright green in general. *Length*, including caudal lamellæ, about 20mm.; greatest *width* about 2·5mm. *Head* pentagonal; rather narrow from front to back; width 4mm.; a few darker and lighter markings on the top. *Eyes* dark; somewhat elliptical; major axis almost transverse. *Antennæ* seven-jointed; basal



Fig. 54.—Caudal lamella of Nymph of Enallagma cyathigerum. (Much magnified.)

two swollen; rest more slender; second long; sixth and seventh intimately united. *Mask* of the usual Agrionine shape (Fig. 53), extending to the insertion of the first pair of legs; a row of six long hairs on each palpus near the margin, and two rows of four or five forming a disconnected line on the body of the mask;

middle lobe obtuse-angled, margin serrated; palpus with inner margin serrated; distal margin notched, and with a sharp, internal point; movable hook rather short, sharp. *Occiput* rather narrow; sides sloping much backwards; corners rather rough; hind-margin very concave. *Prothorax* somewhat pentagonal; lateral corners rather sharp and dark. *Thorax* fairly smooth, and uniform in tint. *Wing-cases* about 5mm. long, reaching about to the end of the fourth segment. *Legs* of moderate length; fore- about 7mm., mid- 8mm, hind- 11mm.; sometimes indications of a ring near distal end of femora; distal end of tibiæ and tarsi rather darker; several longitudinal lines of rough points; no hairs visible in dry specimens; rather longer spines on tibiæ and tarsal joints. *Abdomen* with a slightly paler line along each side; a mid-dorsal, broad, dark line on all the visible segments except the tenth, containing a large elliptical, or pear-shaped pale basal spot, this spot having in its centre a longitudinal still paler line; on the sutures two mid-dorsal dark spots, with a fainter one on each side; upper surface of abdomen with numerous small rough points; end of tenth segment triangular, apex being dorsal and raised somewhat, margin with a ring of points. *Caudal lamellæ* 5·5mm. long, broad, sharp-pointed; tracheæ much-branched and conspicuous; a dark cross-line a little beyond the middle of each lamella, and generally a fainter one more distal and parallel to it; margin spiny along the basal part as far as the cross-line, hairy round the distal part (Fig. 54). [Bred on several occasions, and empty nymph-cases found when the imagines were emerging.]

Date.

Not only is this species one of the earliest to appear in the spring, but it is also one of the last to disappear in the autumn. Mr. C. A. Briggs records it as early as April 28, in 1893, at Ockham Common, while in 1897 I saw it at Esher Common as late as September 29. It is, however, possible that there is a second emergence in the latter part of the season, or, at any rate, that individuals continue to emerge irregularly during the summer.

Habits.

Ponds, canals, lakes, and streams, where the surface of the water is not too much hidden by water-weeds, appear to be the favourite haunts of this delicately-coloured little Dragonfly. Here, amongst the rushes and long grass near the banks, or often, if the sun is shining, over the surface of the open water, they may sometimes be seen in swarms. Often, too, numbers may be found sunning themselves on dry land, flying close to the surface of the ground, and this is the cause, no doubt, why, on Esher Common, so many are captured by the snares of the Round-leaved Sundew (*Drosera rotundifolia*). This Dragonfly often haunts the same locality as its very close relative, *A. puella*, though one is usually more plentiful than the other. The range of the former, however, is much more extended in the British Isles than that of the latter.

Distribution.

Though no localities have been noted for Wales, it may fairly be assumed that *E. cyathigerum* is well

distributed throughout the British Isles, but as in the case of other common species, few seem to have troubled to record its occurrence. The following have come to hand :—*Shetland :* North Delting, Mainland (R. Godfrey). *Inverness :* Strathglass, very common, Kinrara, in Kingussie district, common (J. J. F. X. King). *Argyle :* Oban (De Selys)*; Dalmally, Ledaig, and Tobermory (J. J. F. X. King). *Perthshire :* Rannoch, abundant (G. T. Porritt); Lochan nan Damh, in the Breadalbane district, probably (K. J. Morton). *Lanarkshire :* Carluke (K. J. Morton). *Cumberland :* Keswick (E. B. Bishop). *Westmoreland :* Near Windermere, immense swarms (W. H. Bath); Grasmere and Rydal Water (J. J. F. X. King). *Lancashire :* Heysham Moss (J. Arkle). *Yorkshire :* Barnsley (J. Harrison); Huddersfield, Wakefield, Askern, and Castle Howard (G. T. Porritt). *Cheshire :* Delamere Forest, very common (J. Arkle). *Staffordshire :* Cannock Chase (R. C. Bradley). *Warwickshire :* Sutton Coldfield, very common (R. C. Bradley). *Cambridgeshire :* Thorney River, common (K. J. Morton). *Essex :* Epping Forest (H. Doubleday, 1871). *Somersetshire :* Exmoor (W. J. L.). *Dorsetshire :* Glanvilles Wootton (C. W. Dale). *Hampshire :* New Forest (W. J. L.). *Surrey :* Richmond Park, Esher Common (plentiful), Ockham Common, Chobham Common, Bookham Common, near Pyrford, and near Byfleet (W. J. L.); Merton (J. S. Brocklesby); Weybridge (J. E. Tarbat). *Sussex :* Near Liphook (W. J. L.). *Kent :* Gravesend Marshes (H. J. Turner). *Ulster :* Armagh (J. J. F. X. King); near Glasslough, Co. Monaghan (K. J. Morton);

CHICHESTER.

* "Revue des Odonates," pp. 208, 209.

Belfast (De Selys).* *Leinster:* Twy Laogh and Coosan Point (J. J. F. X. King); Dublin (Miss Ball, *teste* De Selys).* *Munster:* Ross Castle, Denough River, and Ardagh Laogh (J. J. F. X. King). *Connaught:* Carrowbeg River, Small, Kip, and Knappagh Laoghs, and Ma'ammee Laogh (J. J. F. X. King). *Jersey:* Probably (R. McLachlan).

* "Revue des Odonates," pp. 208, 209.

CHAPTER VII.

REPUTED BRITISH SPECIES.

BESIDES the thirty-nine (or forty) species of Dragonflies treated in the preceding pages, about seven others have found places on the British list. None of them can now, however, lay a satisfactory claim to a position there. In most cases only one, or else two, examples have occurred; in all cases the occurrence took place a long time since; and in several cases the authenticity of the capture stands on a very insecure foundation. Four of the species here referred to belong to the *Anisopterides*, and therefore might have arrived as "casual immigrants." The other three are *Zygopterides*, with regard to which such a supposition seems out of the question. All three of the last belong to the genus *Lestes*, the species of which genus are not very easily distinguished, and if they ever were here it appears necessary to draw the conclusion that they were here as natives. It will be well to examine as closely as may be the case for each of these seven insects *seriatim*.

1. **Leucorrhinia pectoralis**, Charp.—At the meeting of the Entomological Society of London on January 2, 1860 ("Proceedings," New Series, v., p. 89), a specimen of this Dragonfly, taken in June near Sheerness, was

exhibited by Mr. Groves. Mr. McLachlan believes that the capture was made on board a fishing boat at the mouth of the Thames; in which case the insect never really landed on British soil. The specimen no longer exists, but, as it was seen by Dr. Hagen, there is no cause for doubting its authenticity. It is a larger insect than *L. dubia*, but resembles it rather closely. In *L. pectoralis*, however, the basal black spot on the fore-wings is small, or absent, the pterostigma is black, and the spot on the seventh segment is yellow in the male, and occupies nearly the whole of the segment.

2. **Sympetrum meridionale,** Selys.—The claim of this insect to a position on the British list rests on two females of old date. One of these, from "near London," was in Evans' collection, which now forms part of that of Mr. C. W. Dale, of Glanvilles Wootton, in Dorset. The other, from the "South of England," was in Wailes' collection, and of it Mr. McLachlan says: "It is truly this species, and bears evidence of having been sent to Mr. Wailes by the late Mr. J. C. Dale, for it bears a label *meridionalis* in the handwriting of the latter." At the sale of Mr. Wailes' collection at Stevens', May 14, 1884, this specimen was bought by Dr. Mason, of Burton-on-Trent. It belongs to the division of the genus possessing crimson body and yellowish legs, and resembles the common *S. striolatum;* but the sides of the thorax are yellow, nearly unicolorous, and without black lines, while in the female the vulvar scale is rounded and not prominent.

3. **Lindenia forcipata,** Linn.—Stephens' collection in the British Museum contains a single female of this

species in poor condition. Of it De Selys says ("Revue," p. 100) that Stephens assured him that he took it near London. Exact date and locality do not seem to be forthcoming, but in any case the insect can only be looked upon as a "casual immigrant." In general colouring it closely resembles *Gomphus vulgatissimus*, but the build of the abdomen is very different in the two species, as are also the shapes of the various yellow markings. The male has remarkable anal appendages, which are doubled in towards each other at right angles.

4. **Gomphus flavipes,** Charp.—In Stephens' collection in the British Museum is a male of this species in good condition. It was captured by Stephens near Hastings, on August 5, 1818; and his "Illustrations of English Insects," Vol. VI., contains a good coloured figure of the specimen. Like the last insect, it is simply a "casual immigrant"; but the exact date and locality give it a better standing. This insect closely resembles *G. vulgatissimus*, but may be known from it by the yellow legs streaked with black, by the dorsal yellow spots being continued beyond the seventh segment to the end of the abdomen, and by the different arrangement of yellowish stripes on the front of the thorax.

5. **Lestes viridis,** Lind.—Of this species De Selys ("Revue," p. 149) says that he saw in Mr. Evans' collection a specimen, which the latter assured De Selys that he took in England. Evans' collection passed into the hands of the late Mr. J. C. Dale, and Mr. McLachlan says that his son (Mr. C. W. Dale) cannot now trace it. (E. M. M., 1884, p. 254.) In the *Entomologist*

(1873, p. 452), Mr. C. S. Gregson says that in the Delamere Forest neighbourhood *Lestes viridis* was plentiful: this, of course, must be a case of mistaken identity. It may be recognised by the large bright russet pterostigma and the whitish-yellow upper anal appendages of the male.

6. **Lestes virens.** Charp. — One specimen was in Stephens' collection, and is now in the British Museum; it was said to have been taken in the New Forest. A second specimen "was recorded from Leach's collection" (McLachlan, E. M. M., 1884, p. 254), or from Stephens' (Hagen Ent. Ann., 1857, p. 57). Mr. H. Doubleday also recorded it from Epping (E. M. M., 1871, p. 87). Mr. Doubleday told Mr. McLachlan that Stephens' specimens were, he believed, taken by himself at Epping, and that Stephens afterwards confounded the localities. In his "British Dragonflies Annotated," in E. M. M., 1884, pp. 251-256, Mr. McLachlan says: "In placing *L. virens* in this category (*i.e.* of species whose British origin is doubtful) I am aware that a doubt is cast upon the late Henry Doubleday's discrimination, owing solely to the great difficulty that often attends the determination of the species of *Lestes*. I never saw Mr. Doubleday's Dragonflies, and it is possible that had I seen them in 1871, I might then have arrived at no satisfactory conclusion with regard to *L. virens*." The species may be recognised by the presence on the under side of the thorax of three tiny black spots on each side to the rear of the hind-legs.

7. **Lestes barbara.,** Fabr. The only claim this insect has to a position on the British list is the presence of a

male in the Dublin Museum, which was *believed* to have been taken in Ireland. On such slender grounds the species should never have been admitted. It may be recognised by the pterostigma, the internal half of which is brown, the external half yellow.

In the earlier British lists, *Libellula sparshalli*, Dale, M. S. (=*Pantala flavescens*, Fabr.) appears, of which Curtis says that it was taken at Horning in 1823 by the late Mr. J. Sparshall, and that it was very similar to a Chinese species. De Selys says that it is "without any doubt erroneous," and in consequence omits it from the "Revue"—a course followed by subsequent writers. (*vide* "Revue des Odonates," p. 260).

Mr. H. Doubleday in his Epping list mentions his having seen a *Cordulia* with yellow markings on the dorsal surface of the abdomen. He took it to be *Oxygastra curtisii*; but Mr. McLachlan suggests that it may have been *Somatochlora flavomaculata*, Lind. (E. M. M. 1884, p. 256).

CHAPTER VIII.

BREEDING THE NYMPH.

When a lepidopterist wishes to obtain specimens of butterflies or moths in the best of condition, he does so by breeding the imago from egg, larva, or pupa. A collector of the *Odonata*, on the other hand, to attain the same object must leave breeding alone, and try to catch the imagines after they have been a week or so upon the wing. Should he, however, desire to study the life-history of the various Dragonflies, equally with the lepidopterist, he must resort to breeding.

It is not an easy matter to obtain living eggs of Dragonflies. To search for them after they have been laid is almost a hopeless task,* nor is it an easy matter to induce the female to deposit its ova in captivity. Occasionally one caught ovipositing may deposit a few more eggs in a collecting-box, and these placed at once in water would no doubt generally hatch. If a female is held by the wings over a vessel

* Mr. A. Müller, writing in the E. M. M., 1871, p. 127, says that by sinking a piece of brown paper to the bottom of a pond, and keeping it down by weights, he secured an egg of *Sympetrum flaveolum*, and a similar method might be employed to obtain the ova of other Dragonflies that simply drop their eggs into the water.

of water, into which the extremity of her abdomen is allowed to dip, she may be induced to oviposit. This method has been adopted with success in the case of *Sympetrum striolatum*, which insect, as well as *S. scoticum*, are species that will sometimes oviposit in a pill-box without the inducement of the water.

From the egg proceeds a tiny nymph, about 1mm. in length, which for its sustenance requires living beings of still smaller size than itself. The difficulty therefore arises of finding materials—water-weeds and mud—containing such tiny creatures, and not at the same time any, large or ferocious enough, to make a meal of the nymph instead. Careful selection and close examination are the means to be employed to attain this end. The same care must be used in the selection of any provender that it may be found necessary afterwards to supply. A little material from a well-stocked pool might be strained through muslin, and the residue, after careful examination, be washed off into the vessel containing the little nymphs.

Since the nymphs at this age, amongst weeds or on mud, are extremely difficult to watch, most naturalists will probably prefer to commence their study of them at a somewhat later stage, and so will try to catch the nymphs when partly grown. With this object search should be made for them, especially between the months of October and May,* amongst the weeds and dead leaves, or on the surface of the mud in ponds,

*Mr. R. M. Whattson says that on the first day's thaw after a severe frost on one occasion, he broke the ice (1½in. thick) on a pool and took more nymphs than he would on a summer's day. They must have been near the surface, as he broke a hole only large enough for the net, which he swept round under the ice (*in litt.*, January 24, 1897).

canals, ditches, and so on, where the various imaginal Dragonflies have in previous seasons been noticed to resort.

In the search the implement employed is a small dredging net about 6in. in diameter, with a stiff iron ring and a tough, but porous, bag (cheese-cloth is a very good material to use). This may be carried in the pocket or satchel, and fastened to a walking-stick at the scene of operations. In addition, several tin boxes will be required in which to carry home the spoil, for the nymphs will live for hours, if not days, packed rather lightly in damp moss, and certainly travel better thus confined than when subjected to continual jolting in a bottle of water.*

When, after a dip, the heterogeneous contents of the net are turned out on the bank, the nymphs—especially the larger ones—often remain quite still for a time, as if feigning death, and as in colour they usually resemble the weeds and mud, or bits of stick and other rubbish, they may easily be passed over; but they soon begin to crawl. In some localities certain of the Agrionine nymphs may be taken in swarms, but other species, that with them or in other localities as imagines are equally common, can only be obtained with the greatest difficulty, and after lengthened periods of dredging.† The search goes on in patience till a sufficient supply of nymphs has been obtained. On reaching home they must be turned out into a basin

* For passage through the post nymphs should be packed in the same way, and they will take no harm from a long journey.

† *Gomphus vulgatissimus* appears to burrow in the mud, and perhaps other flat-bodied species may do the same.

of water and carefully sorted, with the assistance of the analytical tables on pp. 40-44. The different species as far as can be ascertained, must be kept separate, and even the individuals of different size, but of the same species, must be treated in the same way, for Dragonfly nymphs have not the slightest hesitation about preying upon their smaller brethren. Indeed, one may even fall a victim to another of its *own* size just after an ecdysis, while the new skin is soft and its owner helpless. It is clear, therefore, that even those of the same size and kind must not be overcrowded; but providing a plentiful supply of suitable food will go a great way to keep in the background their cannibal instincts.

With regard to food, the common fresh-water shrimp (*Gammarus fluviatilis*) seems to be much relished by many of the larger nymphs—the *Anisopterides*. In the spring tadpoles may be given, and to the Æschnas a tiny red worm always appears a tempting morsel. But most living creatures that are not too large are readily taken. A slender Myriapod once given to a large nymph was, however, quickly rejected with signs of evident dislike. The *Zygopterides* require smaller provender, and for them water-fleas, or animals of about that size, are suitable; but they are able to see and take very small creatures, and also, on the other hand, larger ones than would be expected.

For purposes of study the nymphs may be kept in ordinary fish-globes containing mud and weeds, and a snail or two to keep the glass clean. Dead leaves and bits of stick should also be supplied, for some nymphs like to hide under the former, and others to rest upon the latter. When the larger nymphs have been kept

thus in captivity for some time they seem to become almost tame, and to watch for their meals. As soon as a shrimp or a worm is dropped into the water the movement seems to be communicated to them, or they sight the intruder, and turn their head on one side to watch it in a very knowing manner. They then stealthily approach. The shrimp perhaps is still for a moment; they wait till it begins to move, then out shoots the mask, and the prey is secured, though not always at the first shot. If a house-fly is dropped on the surface of the water its struggles soon attract a nymph, which comes up to the surface to fetch it, and in that case the whole process of capture may be easily observed.

When the time for emergence is near at hand pieces of stick, with knots or projections to give foothold, must be fastened in an upright position in the fish-globes, or other aquaria, so that the nymphs may be able to leave the water for their final change. It is not easy to secure the sticks in the requisite position in a glass fish-globe; but the exercise of a little ingenuity will no doubt bring about the required result. Every part must overhang the water, for restless nymphs sometimes fall before they have finally taken up a position for the change.

At certain intervals the growing nymph will cast its skin, and these casts should be preserved in alcohol or a from 2 to 5 per cent. solution of formalin. In addition skins from which the imagines have emerged should be preserved, either in the solutions just mentioned, or mounted on pieces of card. In the latter case different specimens should be placed in various positions, so that by the aid of one or other all parts may be

examined. Should only a single nymph-case be obtained, it may be mounted at the end of a thin strip of cardboard, placed at right angles to the long axis of the body. The empty case is extremely light, and a very small surface need be in contact with the card. The spot chosen had better be about half-way down the ventral surface of the abdomen, where nothing that is likely to need examination is found. The pin and label should be placed at the other end of the strip of cardboard. If a good supply of nymphs is available, some had better be preserved in one of the solutions before the imagines emerge. The mounted nymphs may be placed in the cabinet with the perfect Dragonflies, or, if they seem to detract from the appearance of the latter, they may be placed in a drawer by themselves, which will allow of comparison with one another, a connection quite as important as that between themselves and the perfect insects to which they give rise.

CHAPTER IX.

PREPARING FOR THE CABINET.

To secure some of the more powerful butterflies is often no easy matter, but the task is a light one compared with that of capturing many of the larger Dragonflies. Not only are their speed and power of flight greater, but they also seem to exhibit a high degree of intelligence in avoiding the collector's net. He must combat this by using a larger net, and possibly a telescopic handle, and by employing strategy, such as hiding motionless by the side of bushes near a Dragonfly's track, so that it may be thrown off its guard, and approach within reach of its enemy's net. When the chance occurs no bungling stroke must be made, or the Dragonfly is usually gone for ever.

We presume, however, that the capture has been made. What is to be done with the prisoner? Pill-boxes of so great a diameter would be required for one of the larger species, that to carry any number home alive will generally be a difficult matter, though it must be done if possible. The smaller species should always be boxed, and if the larger must be killed on the spot, the cyanide bottle should be used, or else benzine or

chloroform, which may be dropped on the thorax. Benzine is quickly effective, but that and chloroform both make the insects stiff for a time, and for the sake of the colours are not recommended. They may then be pinned in the collecting-box, or folded in papers, but not tightly enough to flatten the abdomen, the paper packet being then pinned in the box.*

In general, within an hour or so the insects must be attended to, if they are to make good cabinet specimens, and here the Odonatist, unlike the collector of the *Lepidoptera*, is confronted with a great difficulty —that of preserving the colours of his captures. Some take no trouble at all about the matter, with the result that, except for size and shape, many of their insects present a uniform appearance—a dingy black-brown hue replacing the gorgeous colouring of the living insects; and it must be confessed that, except in a few species, in which the colours fade but little in any case, the freshness and brightness of the original tints will always depart to a great extent. But with care and attention something may be done.

If the insects are kept without food for a day or two—a state of affairs to which they must be accustomed in dull weather—the intestines become practically empty, and when they are killed there is little to decompose, consequently the colours fade but little, for

* Dr. Hagen recommends folding the Dragonflies alive in paper in this way, and pinning the packet in the collecting-box.—"Entom. Weekly Intelligencer," vol. iv., p. 88. Mr. J. J. F. X. King suggests the use of a circular tin box, in which the Dragonflies may be placed in layers. After an insect has been killed, and its wings have been folded, it is placed in the box and covered with a disc of paper ready cut; another Dragonfly is placed on this, and then another sheet of paper, and so on, till the box is full.

it appears to be the decomposition of the contents of the body that causes the loss of colour. It will soon be discovered that a certain number of specimens do not lose their colours even if they receive no special treatment, and the cause of it may be that they have been fasting. Hence it is suggested that the morning is a good time to collect, especially after a period of dull weather. To obtain specimens while the intestines are empty, or to keep them alive till that consummation has been reached, is the only course of procedure that it is open to pursue in the case of the *Agrionina*.

With many of the larger species most collectors will take stronger measures than this. The usual method is with a pair of sharp-pointed dissecting scissors to make a slit *as soon as possible after death* along the ventral surface of the abdomen. Then, the insect being held in the left hand by the wings,* the points of a pair of rather slender dissecting forceps are inserted in the slit near the thorax. With these the intestines are seized, and, if care is used, nearly the whole of the contents of thorax and abdomen are brought away together in one long tube. What is left must be picked away little by little, if possible, without touching the inside of the skin, for it is in a delicate film there situated that the colouring matter is to be found. If the specimens are needed for study afterwards the slit must not extend to the ninth and tenth segments, nor must the second segment of the male be interfered with. But perhaps the best thing would be

* Or it may be fastened down on its back to a sheet of cork with two very fine pins.

to keep, where possible, a few specimens intact especially for purposes of study.

When the abdomen has been cleaned as thoroughly as possible with the forceps, it must be dried, and perhaps stuffed ; no washing with either water or benzine should be attempted.* The author simply dries the specimens as rapidly as possible, leaving the abdomen as an empty case, which, contrary perhaps to expectation, is not at all brittle ; it sometimes, however, contracts a little transversely. Some recommend stuffing the empty abdomen with a roll of paper or cotton-wool (coloured it may be to resemble the tints of the living insect), or even with a straw or piece of matchwood. Of these the roll of wool appears to be the most suitable packing, but care must be used, or the abdomen may be unnaturally distended, and that irregularly.

After the contents of the abdomen have been extracted, some Odonatists shake loosely inside the skin powder of a colour similar to that of the Dragonfly. Others, again, paint the inside of the skin of the proper tint, while some even go the length of painting the outside. But all of these methods, even the insertion of the coloured wool or paper, which attempt artificially to reproduce the colours that have gone, are to be deprecated : good coloured drawings would be better than specimens so tampered with.

Other means of preserving the colours have been suggested. One due to Professor Stephanelli, and mentioned in "Science Gossip" (October, 1895, p. 204)

* Mr. F. Milton, however, writing in the *Entomologist*, 1887, p. 285, advises dropping into the skin benzine or benzole, and absorbing it and the dissolved grease with carbonate of magnesia.

by Mr. W. H. Nunney, is to dry the insect under the receiver of an air-pump, and when the air is exhausted to replace it by sulphuric ether. Sulphuric ether alone, it is there stated, injected into the bodies of Dragonflies will frequently preserve the colours.

Mr. Nunney himself brings forward quite a revolutionary method. Instead of drying the insects he attempts to keep them perpetually moist, and the preparation he finds most successful is that known commercially as Professor Barff's boro-glyceride. Of his method he says: "After making the usual longitudinal slit in the under-side of the creature's body, I withdraw so far as possible the contents, and afterwards fill the cavity with the boro-glyceride of the ordinary commercial strength, without allowing the chemical to in any way soil the outside of the body. The result is, that whilst the colours are preserved the body never entirely dries, and consequently cannot be broken off by any shock given to the cabinet, drawer, or store-box, this last being another great advantage of the use of a slightly deliquescent antiseptic. In the case of the smaller *Agrionidæ*, I inject the boro-glyceride, slightly weakened by the addition of water, with a very fine hypodermic syringe, into the body extremity, and, if necessary, run in the usual bristle for strengthening purposes." Mr. Nunney states that the colours of an *Æschna cyanea* treated by this method were as bright after two years as they were when the insect was alive. Probably few entomologists, however, would care to admit insects so treated into their cabinets, and as regards specimens needed only for study the treatment is unnecessary, for they may be kept in spirit, which preserves the

colours almost without change. The reagent formalin, which is now taking the place of spirit to a great extent as a preservative, since it has the great merit of not rendering brittle the insects placed in it, does not seem so safe in the matter of colour preservation.

Mr. S. L. Mosley, in the E. M. M., 1876, p. 89, suggested filling the bodies with plaster of Paris till they were dry. But, apart from the weight of the substance and the chance of its setting inside the abdomen, the method does not appear very practicable, seeing that it is necessary to set the insects as soon as they have been eviscerated.

It is usually the custom, with those Dragonflies that

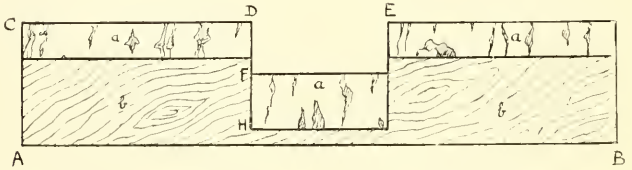


Fig. 55.—Setting-Board for Dragonflies.

a., Cork. *b.*, Deal.

are not eviscerated, to pass a grass-stem or bristle from the thorax into the abdomen to keep them from breaking at the segmental sutures when they are dry. The insects to be so treated will be the genera *Leucorrhinia* and *Sympetrum*, the sub-families *Corduliinæ*, and perhaps *Gomphinæ*, and the family *Agrionidæ*. For the last a shoemaker's bristle is very suitable, or for the very smallest even a horsehair. In no case must the grass-stem or bristle disarrange the ninth or tenth segment, or the second of the male.

Whatever may be the merits or demerits of curved setting in the case of *Lepidoptera*, there can be no doubt that the *Odonata* should be set flat. Moreover, in order to enable the legs to be properly arranged, the board must have a wide rectangular groove to contain them. A form of board, of which Fig. 55 is a cross-section, is recommended, the parts marked *a* being made of cork, and *b* of deal. The cork on the upper surface may be dispensed with if entomological pins are not used for setting. Five boards with the following dimensions are convenient sizes :

	A B	D E	D F
1.	120mm.	27mm.	10mm.
2.	100	25	8
3.	72	22	6
4.	55	15	4
5.	45	12	2

A C and F H will, of course, vary according to the height any particular collector wishes his insects to appear up the pin. For moderately low setting A C should be 25mm.

Since a Dragonfly may be handled without fear of damaging it, setting presents no great difficulties. The pin should be thrust vertically through the centre of the thorax, care being taken that the point does not pass through a leg and detach it. The Dragonfly having been pinned in the centre of the groove, a small piece of cardboard attached to a pin (Fig. 56) must be so placed as to prop up the head in the proper position. The upper surface of the thorax having now been brought down level with the surface of the board, the legs should be placed in the position indicated in Fig. 57. This is not the natural position,

but it allows better of their examination. Often the claws cling to the board and keep the legs in position, but sometimes it is necessary to use pins. The wings next require attention, and some system of arrangement had better be fixed upon from the first. The author makes it a rule to have the costal margin of the hind-wings in a straight line, and the fore-wings at some such

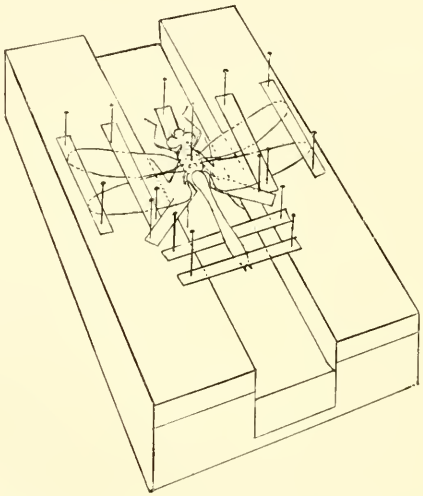


Fig. 56.—Diagram to Illustrate the Method of Setting a Dragonfly.

angle with them as that in Fig. 57. They should first be held in position by the inner pair of braces. Then the anal angles, which are often very important for classificatory purposes, and therefore should be clearly displayed, must be kept horizontal by means of two strips of thin cardboard or stiff paper, as in the illustration. This being done, the tips of the wings

should be fixed in position by means of a second pair of braces. Tracing-paper is a very good material to use for the braces. The abdomen will generally require one or two braces above and below it to keep it horizontal, and possibly a pin on each side to prevent it from moving to the right or to the left. These braces must not be so tight as to flatten the body. A label with date and locality of capture placed with the insect

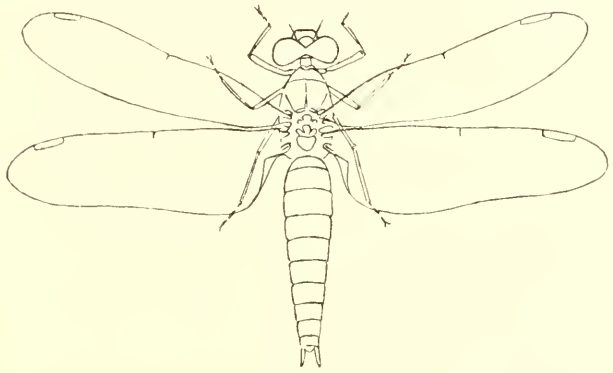


Fig. 57.—Dragonfly Set and Ready for the Cabinet.

completes the process of setting. About a fortnight for the smallest species, and from three weeks to a month for the larger ones, will be required before they may safely be removed from the setting-boards. In transferring an insect care must be taken that the legs are not knocked off in removing the pins or by the hooks at the end of the legs clinging to the surface of the board. The appearance of the Dragonfly when set and ready for the cabinet should be that presented by Fig. 57.

From various circumstances, Dragonflies, like other insects, often need relaxing before they can be set, or in order to reset them in a different style. This may be done in the ways that are usual for *Lepidoptera*. They may be put in a damp zinc relaxing-box, or they may be placed over damp sand, or floated on cork over water. In each case the vessel containing them should be closed, and the whole apparatus kept slightly warm. Setting must not be attempted till the insects are thoroughly relaxed.

Recently pyroxyllic spirit—purified wood-naphtha—has come into use for relaxing *Neuroptera*, &c. The joints, and all parts of the insect that need relaxing, are moistened with the spirit by means of a paint-brush, and after about a quarter of an hour or so the insect may be set. It will be ready for the cabinet next day. This method is recommended, but the spirit should not be used too freely or the legs may be detached.

Dr. H. G. Knaggs (E. M. M., 1896, p. 101) suggests the following method for relaxing insects: The apparatus required is an accurately stoppered, wide-mouthed 3oz. bottle and a piece of sheet cork in the form of a circle with a long pin stuck in its centre as a handle. Into the bottle $\frac{1}{4}$oz. of sublimated naphthaline (not ordinary albo-carbon) and about six drops of wood-naphtha are to be introduced. The insects are pinned on the stage, and in forty-eight hours relaxing is complete.

A laurel-jar would no doubt give satisfactory results as with the *Lepidoptera*.

When a relaxed Dragonfly is taken off the boards it is perhaps well to just touch the junction of the

wings and thorax *below* with a little liquid glue, for, more than in other insects, the wings seem liable to spring after a time.

One point which remains to be considered is the number of specimens of each species to be placed in the collection. Apart from the size of the cabinet and the plenty or scarcity of the various species, liability to vary—a point which has been already discussed in connection with the various species—should be a great determining factor. Possibly also most collectors will like to have a good series of such as keep their colours well, and so make a good show in the cabinet.

A collection of Dragonflies admits of very easy labelling, and one of the comparatively large spaces on each side of the abdomen below the hind-wings seems marked out for the position of a neat label bearing particulars of locality and date of capture; but this should only supplement a fuller account in the collector's note-book in connection with all the less common species or more striking varieties.

ADDENDA ET CORRIGENDA.

Page 44.—Owing to the finding of several of the Agrionine nymphs during 1899, that part of the Table on page 44 may be extended as follows:

B. All appendages lamellar.
 I. Lamellæ rounded at tip.
 a. Lamellæ very long, blotched; antennæ long and slender; mask *very* slender — *sponsa*.
 b. Lamellæ spotted and banded; mask and antennæ of the Agrionine type .. — *naias*.
 II. Lamellæ pointed at tip.
 a. Lamellæ coloured.
 1. Lamellæ rather short and broad, mottled with brown; body comparatively short and stout — *nymphula*.
 2. Lamellæ long, narrow, spotted; eyes rather large; sides of abdomen spiny — *pennipes*.
 b. Lamellæ hyaline except the tracheæ, and sometimes one (or two) small transverse streaks.
 1. Lamellæ with one margin only hairy — *pumilio*.
 2. Lamellæ with both margins hairy or spiny.
 i. Several segments of abdomen marked dorsally with four dark, curved, longitudinal lines — *elegans*.
 ii. Abdomen with a darker longitudinal streak, thickest at the base of the segments on each side of medio-dorsal paler line — *puella*.

iii.	Pale mid-dorsal line, bounded by darker one, still darker at sutures; two spots on each segment; lamellæ small ..	*mercuriale.*
iv.	Dorsal surface of abdomen with a large central dark patch on each segment (except 10), containing a pale, pear-shaped or triangular one, and this last a central pale streak; lamellæ rather broad, pointed, a thin dark line across the middle	*cyathigerum.*

Page 74.—For description of nymph of S. STRIOLATUM, see page 90, and explanatory note on page 91.

Page 75.—S. STRIOLATUM. *Dorset:* Glanvilles Wootton (C. W. Dale); entrance to Poole Harbour (W. J. L.). *Berkshire:* Wellington College (J. E. Tarbat). *Surrey:* Chertsey (E. Vincent); Woking (W. D. Drury).

Page 86.—S. FLAVEOLUM has again (1899) occurred in some numbers on Ockham Common, in Surrey. As in 1898 no females were noticed, and we must conclude that there has been another migration. Mr. B. Harwood, however, captured a female at S. Osyth, Essex, on August 21.

Page 99.—S. SCOTICUM. *Surrey:* Chobham Common and Chertsey (E. Vincent).

Page 106.—L. DEPRESSA. *Devonshire:* Near Plymouth (G. C. Bignell). *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 117.—L. QUADRIMACULATA. *Argyllshire:* (J. Mackay). *Hebrides:* Stornoway (H. S. Fremlin).

Page 121.—L. FULVA. *Dorset:* One at Wootton Wood, May 24, 1825, by J. C. Dale. (History of Glanvilles Wootton, by C. W. Dale.)

Page 125.—O. CÆRULESCENS. *Devonshire*: Near Plymouth (G. C. Bignell). *Hampshire:* Hengistbury Head, near Christchurch, one (W. J. L.).

Page 129.—O. CANCELLATUM. *Surrey:* Chobham Common (E. Vincent).

Page 136.—S. METALLICA. *Inverness-shire:* Seen for two months from June 15, 1899, in Strathglass and Glen Affrick, the female being very scarce. (J. J. F. X. King, E. M. M., 1899, p. 206.)

Page 140.—S. ARCTICA. *Inverness-shire:* Taken in Strathglass, in June, 1899, and in Glen Affrick early in August, in the latter locality at an altitude of 1400ft. (J. J. F. X. King, E. M. M., 1899, p. 206.)

Page 146.—C. ÆNEA. *Hampshire:* New Forest (W. J. Ashdown).

Page 162.—C. ANNULATUS. *Devonshire:* Near Plymouth (G. C. Bignell). *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 170.—A. IMPERATOR. *Dorset:* One on Roundchimneys Pond, July 24, 1864 (C. W. Dale, History of Glanvilles Wootton).

Page 183.—Æ. MIXTA. *Dorset:* Stockhill, one, October, 1807, J. C. Dale (C. W. Dale, History of Glanvilles Wootton).

Page 189.—Æ. CÆRULEA. *Inverness-shire:* Observed 1899 in widely separated districts in Strathglass and Glen Affrick, at altitudes from 400ft. to 1200ft. Last taken, a male, on August 12. (J. J. F. X. King, E. M. M., 1899, p. 206.)

Page. 195.—Æ. JUNCEA. *Somersetshire:* Exmoor (W. J. L.). *Hebrides:* Stornoway (H. S. Fremlin). *Dorset:* Brook Furlong, August 13, 1822, by Curtis (C. W. Dale, History of Glanvilles Wootton).

Page 202.—Æ. CYANEA. *Devonshire:* Near Plymouth (G. C. Bignell). *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 208.—Æ. GRANDIS. *Surrey:* Near Chobham (W. H. Aston).

Page 219.—C. VIRGO. *Devonshire:* Near Plymouth (G. C. Bignell). *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 227.—C. SPLENDENS. *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 237.—L. SPONSA. *Surrey:* Chobham Common (E. Vincent).

Page 237.—LESTES FORCIPULA (? = L. SPONSA). *Dorset:* Glanvilles Wootton (C. W. Dale).

Page 252.—E. NAIAS. *Surrey:* Chobham Common (E. Vincent).

Page 260.—P. NYMPHULA. *Hebrides:* Stornoway (H. S. Fremlin).

Page 275.—I. ELEGANS. *Hebrides:* Stornoway (H. S. Fremlin).

Page 305.—E. CYATHIGERUM. *Hebrides:* Stornoway (H. S. Fremlin). In E. M. M., 1899, p. 207, Mr. R. McLachlan gives an interesting account of his observation of the submergence of the female.

Page 310.—In Mr. C. W. Dale's History of Glanvilles Wootton, in Dorset, L. VIRIDIS is said to be occasionally common. This must, of course, be intended for some other species.

Page 22, line 13, insert comma after "may be."

Page 27, line 15, for "possibly" read "possible."

Page 36, line 3, for "hooks" read "joints."

Page 37, for "CORDULIIDÆ," in inscription to Fig. 15, read "CORDULIINÆ."

Page 38, for "Fig. 43" read "Fig. 44."

Page 44, line 13, for "six-jointed" read "obscurely seven-jointed."

Page 48, for "Figs. 23 and 24" read "Figs. 22 and 23."

Page 58, lines 22 and 36 }
Page 62, line 31 } for "Platychnemis" read "Platycnemis."

Page 61, line 30, for "Plate xxvi." read "Plate xxvii."

Page 61, line 37, insert comma after "circlet."

Page 108, line 10, insert comma after "macula."
Page 124, line 5, insert "in" after "same as."
Page 139, line 7, for "*lower*" read "*upper*."
Page 231, line 25, for "seitenstachel" read "Seitenstachel."
Page 231, line 26, for "kiemen" read "Kiemen."
Page 238, line 17, for "Reisem" read "Reisen."
Page 273, line 25, between "head" and "thorax" insert "and."
Page 276, line 10, insert comma after "New Forest."

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Ann. Soc. Ent. Fr.—"Annales de la Société Entomologique de France."

Bull. Acad. Belg.—"Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique—Bulletins."

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Specific synonyms may be recognised by the small initial letter without any indentation.

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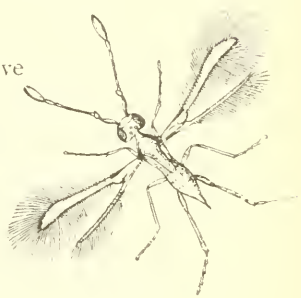
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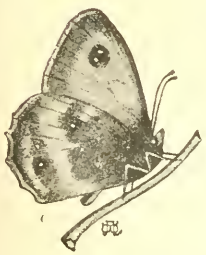
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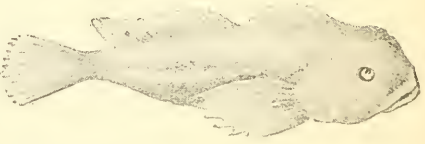


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